

DSSAT version 3

VOLUME 2

A **D**ecision **S**upport **S**ystem
for **A**grotechnology **T**ransfer

Volume 2

DSSAT version 3

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IBSNAT, The International Benchmark Sites Network for Agrotechnology Transfer, is a network consisting of the contractor (University of Hawaii), its subcontractors and many global collaborators. Together they have created a network of national, regional and international agricultural research for the transfer of agrotechnology among global partners in both developed and lesser developed countries.

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DSSAT v3

VOLUME 2

VOLUME 2-1

INPUT & OUTPUT FILES

VOLUME 2-2

CROP MODELS

VOLUME 2-3

GRAPHING SIMULATED AND
EXPERIMENT DATA

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VOLUME 2-1

INPUT AND OUTPUT FILES

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CHAPTER ONE.

INTRODUCTION

For over twenty years scientists and engineers have been developing process-oriented simulation models of various crops. Models have been published for most of the world's major food crops as well as for cotton, tobacco, grasses and ornamental crops. These models generally describe the development, growth and yield of a crop on a homogeneous area of soil exposed to certain weather conditions.

The objectives of crop modelers have varied, from understanding mechanisms of plant growth processes, to assisting in management and decision making. Although there are considerable differences in the mathematical structures, the processes included, and the levels of detail and mechanism in each model, there are also some major similarities. Most models are deterministic, operate on daily time steps and require similar input data for soil, weather and management conditions. Models developed for application to conditions other than those in an experiment usually only require weather and soil data that are widely available, and produce outputs that are of general interest to people studying crop management or to those interested in decision making and planning.

Many scientists routinely collect experimental data that can be used to validate and improve existing crop models. These data represent a valuable resource for testing future models. However, to provide easy-to-use data sets for future model testing, and minimize unnecessary manipulation of data, a set of standards is needed for organizing the data files. Crop models which predict crop performance in differing environments are appealing to users from diverse disciplines. Many of these model users need application programs which perform analyses on model outputs. Other users working with spatial data bases may utilize programs which interpolate model inputs between points. Operation of these application programs requires inputs and outputs in a standard form.

In recent years, the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) has published documentation for a set of crop model inputs and outputs (IBSNAT, 1986, 1990). This system of files and data formats was used for the models integrated into the Decision Support System for Agrotechnology Transfer (DSSAT v2.1) (IBSNAT, 1989), in which corn, wheat, soybean, and peanut crop models all used the same database software and strategy evaluation program. This system was useful for running and validating

the models, for conducting sensitivity analysis, and for evaluating the variability and risks of different management strategies for a range of locations specified by soil and weather data. The attempt to develop and use general files and formats provided a good start and demonstrated the utility of the endeavor. However, the introduction of other crops (such as rice), the introduction of other models of the same crops, and the introduction of other processes into the existing models revealed several deficiencies. Further, the large number of files presented difficulties to many users. Work was initiated, therefore, to develop a more universal set of files.

The work reported by IBSNAT (1986, 1990) provided a basis for many of the files and file structures presented here. In that original work, the inputs and outputs were limited to those that described weather, soil water and nutrient conditions, row and planting geometries and crop management. In the current document, not only have those inputs and outputs been expanded but they are now more flexible, have more variables and contain additional environmental conditions. The inputs and outputs refer to a point in space and do not include watershed or other spatially varying conditions. The present structure, however, is sufficiently flexible to easily allow additions of these and other factors in the future.

A utility program called Convert (see Volume 1-5, Imamura and Tang 1994, of this book) is available in DSSAT v3 to convert DSSAT v2.1 files to the new file structure. Moreover, if a user wishes to create a new experiment data set for DSSAT v3, there is a utility program called XCreate (see Volume 1-4, Imamura 1994, of this book) which creates the new crop management or experiment input file which is referred to as FILEX.

The files and file structures described here are designed to accommodate a diversity of crop models and applications. Their specifications are the basis of the data structures used in DSSAT v3. They have been constructed to facilitate the exchange of data among modelers and other users and can be used as direct input to crop models. They also may function as a medium to generate model-specific input files and keep intact the facility for data set interchange. Considerable thought has been given to designing a system to maximize the flexibility of input configurations. This flexibility has often meant specification of a considerable number of “slots” for inputs. Within this document, examples of minimum configurations of input files for particular applications are highlighted (see the section entitled, “Examples of FILEX for Various Experiments”).

CHAPTER TWO.

FILE STRUCTURE

The files are organized into input, output and experiment performance data files (Table 1). A typical organization of these is depicted in Figure 1. The experiment performance files are needed only when simulated results are to be compared with data recorded in a particular experiment. In some cases, however, they could be used as input files to ‘reset’ some variables during the course of a simulation run. They could also be used to record time series of pests or pest damage to the crop, which could be used as input to crop models. The model output files are organized to allow users to select the information needed for a particular application. Similarly, model inputs are organized to allow some flexibility in their use with specific models. For example, there is a soil nutrient management section that users could eliminate when their crop model does not include a soil fertility component or when fertilizer was applied to eliminate nutrient stresses.

FILE ANNOTATION

Each file should contain file headings, and, if the file is partitioned into sections, section headings. In addition, it is often desirable to add remarks to data contained within a file. These remarks may be header lines indicating the nature of following data items or may be comments on some aspects of the quality or source of the data. Headers may be used by the input components of a model to undertake particular operations, while comment lines would generally be ignored. The following symbols, placed in column 1, indicate the nature of the annotation:

- * file or section heading
- @ header line specifying variables occurring below
- ! comment line.

FILE NAMING CONVENTIONS

A set of file-naming conventions have been adopted to facilitate recognition of different categories of data. The convention has two parts: 1) the file extension which is used to specify the type of file; and 2) the prefix which is used to identify the contents of the file. Following is a list of extensions and prefixes.

EXTENSIONS

- .WTH Weather data file
- .SOL Soil profile data file

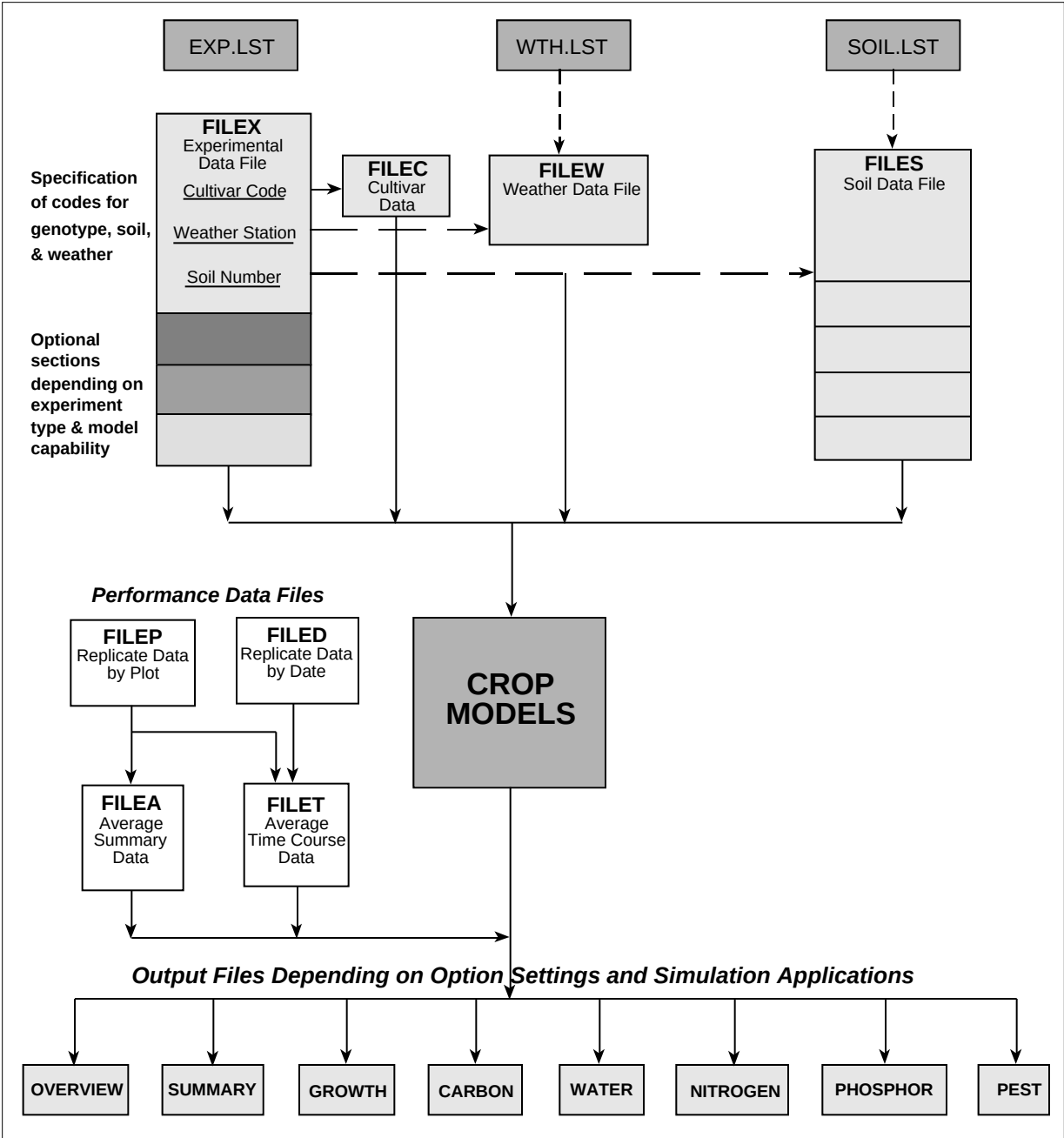


FIGURE 1. OVERVIEW OF INPUT AND OUTPUT FILES USED BY CROP MODELS.

.CUL	Cultivar / variety specific coefficient file
.ECO	Ecotype specific coefficient file
.SPE	Crop (species) specific coefficient file
.OUT	Output file generated by the crop model
.LST	A list file - provides a list of either experiments, weather data sets or soil data sets
.ccX	Experiment details file (i.e., FILEX)
.ccP	Observation data (replicate values)
.ccD	Performance data (replicate values)
.ccA	Average values of observation data
.ccT	Time course data (averages)

The 'cc' in the above extensions indicates a crop code (e.g., WH). The current crop codes used are listed below:

<u>Code</u>	<u>Crop</u>
AL	Alfalfa / Lucerna
AR	Aroid
BA	Barley
BN	Dry bean (Phaseolus bean)
BW	Broad leaf weeds
CO	Cotton
CS	Cassava
FA	Fallow
GW	Grass-weeds
ML	Pearl millet
MZ	Maize / Corn
PN	Peanut
PT	Potato
RI	Rice
SB	Soybean
SC	Sugar cane
SG	Sorghum
ST	Shrubs / Trees
WH	Wheat

PREFIXES

For most model input files and experiment observation files, the prefix is constructed from an institute code (2 characters), a site code (2 characters), the year of the experiment (2 characters) and an experiment number (2 characters). For

example, an experiment conducted by the University of Florida (UF) at Gainesville (GA) in 1988 (88) would yield a file prefix of UFGA8801. The file prefix conventions used for output files and genotype coefficient files are shown in Table 1.

MISSING DATA

For all input files, the value ‘-99’ is entered when required numeric data are missing or unavailable.

CHAPTER THREE.

INPUTS

Input files are further divided into those dealing with the experiment, weather and soil, and the characteristics of different genotypes (crop and cultivar) (Table 1).

EXPERIMENT LIST FILE

The EXP.LST file (or FILEL) contains a listing of available simulation experiments (Table 2). This file contains no information on individual experiments, but lists all of the experiment files available in the working directory, having one line of information for each experiment. First on this line is the optional experiment list number. There is a blank space and then there is the experiment identifier which specifies the institute code, site code, year of experiment, and experiment number (see the “Prefixes” section above). There is a blank space and then three characters. The first two characters are used for the crop species code (which can specify a group of species as well as one individual species, e.g., WH for Wheat), and the third character defines the file type; the default file type for the IBSNAT models is “X” (see example in Table 2). There is a blank space and then the next field of 60 characters briefly describes the experiment, usually by giving the experiment name. If there are any peculiarities of the experimental conditions at the specific site, these should be added after the experiment name, using a semicolon to separate the two items. Finally, factors included in the experiment, and the number of levels for each factor, should be documented in abbreviated form (e.g., cultivars as CV; irrigation as IR, etc.) and added after the experiment name, each one separated by a semicolon. For each experiment file available for simulation, one line of information, equivalent in content to the one just described, must be placed in the EXP.LST file. Typically, during model execution, this experiment list would appear as a menu from which the user could select an experiment for simulation.

The IBSNAT models are organized to allow users to perform sensitivity analysis, and in such cases, weather data files, soil profiles and other data files (as necessary) are needed and a listing of these, in a form the models can read, must be generated by the user through a utility found in DSSAT v3, so users can select alternate files during a simulation. Examples of a weather list file (WTH.LST) and a soil list file (SOL.LST) used by crop models in DSSAT v3 are given in Appendix A. These list files may be model-specific and are not essential for documenting basic model inputs and outputs.

TABLE 1. CROP MODEL INPUT AND OUTPUT FILES.

Internal File Name	Example File Name(s)	External Description
INPUT FILES		
<u>Experiment</u>		
FILEL	EXP.LST	Listing of all available experiment details files (FILEXs)
FILEX	UFGA8801.SBX	Experiment details file for a specific experiment (e.g., soybean at UFGA): treatments, field conditions, crop management and simulation controls
<u>Weather and Soil</u>		
FILEW	UFGA8801.WTH	Weather data, daily, for a specific (e.g.,UFGA) station and time period (e.g., for one year)
FILES	SOIL.SOL	Soil profile data for a group of experimental sites in general (e.g.,SOIL.SOL) or for a specific institute (e.g., UF.SOL)
<u>Crop and Cultivar</u>		
FILEC	SBGR0940.CUL ^{1,2}	Cultivar/variety coefficients for a particular crop species and model; e.g., soybean for the 'GR0' model,version 940 (i.e., released in 1994)
FILEE	SBGR0940.EC0 ³	Ecotype specific coefficients for a particular crop species and model; e.g., soybean for the 'GR0' model,version 940(i.e., released in 1994)
FILEG	SBGR0940.SPE ³	Crop (species) specific coefficients for a particular model; e.g., soybean for the 'GR0' model, version 940 (i.e., release in 1994)
OUTPUT FILES⁴		
OUTO	OVERVIEW.OUT	Overview of inputs and major crop and soil variables.
OUTS	SUMMARY.OUT	Summary information: crop and soil input and output variables; one line for each crop cycle or model run.

OUTG	GROWTH.OUT	Detailed time-sequence information on:
OUTC	CARBON.OUT	Growth
OUTW	WATER.OUT	Carbon balance
OUTN	NITROGEN.OUT	Water balance
OUTP	PHOSPHOR.OUT	Nitrogen balance
OUTD	PEST.OUT	Phosphorus balance
		Pests, diseases, weed damage/levels

EXPERIMENT DATA FILES

FILEP	UFGA8801.SBP	Performance data (replicate values, arranged by plots) for a soybean experiment. (Used for basic experimental data from which averages and time course data are calculated.)
FILED	UFGA8801.SBD	Performance data (replicate values, arranged by date) for a soybean experiment. (Used for basic experimental data from which averages and time course data are calculated.)
FILEA	UFGA8801.SBA	Average values of performance data for a soybean experiment. (Used for comparison with summary model results.)
FILET	UFGA8801.SBT	Time course data (averages) for a soybean experiment. (Used for graphical comparison of measured and simulated time course results.)

- ¹ These names reflect a standard naming convention in which the first two spaces are for the crop code, the next five characters are for the model name, beginning at position 3, and the final one is a file identifier that in general is set to zero.
- ² General names (e.g., SOYBEAN.CUL) have been reserved for those cases where the data requirements are truly model independent.
- ³ These files are used by the 'GRO' models, but other crop models may not need them; thus FILEC is the only required Cultivar file for running all crop models.
- ⁴ The example names for the output files (e.g., GROWTH.OUT) are for temporary files that are rewritten during each simulation run. Output files can be saved, however, and in this case the file names are made up of the usual institute, site, experiment and crop identifiers, with a final letter, G, W, etc., to designate growth, water or other data types. (An example of a saved OVERVIEW output file would be UFGA8801.SBO, where the "O" designates Overview; other examples would be UFGA8801.SBS,G,C,W,N,P,D where the letters designate Summary, Growth, Carbon, Water, Nitrogen, Phosphorus and Pest output files, respectively.)

TABLE 2. EXPERIMENT LIST FILE. (FILEL = "EXP.LST")

STRUCTURE

Variable	Variable Name ¹	Header ²	Format ³
Experiment list number ⁴	EXLTN	#	0 I 2
Experiment identifier, generally made up of: Institute code (2 characters) Site code (2 characters) Experiment code (4 characters)	EXPER	FILENAME	1 C 8
File extension (where the 1st two characters are the crop group code(e.g., "WH") ⁵	EXT	EXT	1 C 3
Experiment name	ENAME	ENAME	1 C 60

¹ Abbreviations used as variable names in the IBSNAT models.

² Abbreviations suggested for use in header lines (those designated with '@') within the file.

³ Formats are presented as follows: number of leading spaces, variable type (Character = C, Integer = I), variable width.

⁴ "Experiment list number" is an optional entry for this line. If it is not used, two blank spaces must be left at the beginning of each line.

⁵ The IBSNAT models use "X" for the third character of the extension.

EXAMPLE

```
*EXPERIMENT LIST
@# FILENAME EXT
ENAME.....
1 UFGA7801 SBX BRAGG, IRRIGATED&NON-IRRIGATED;2IR
2 UFGA8101 SBX COBB, IRRIGATED+VEG+REPROD.STRESS;3IR
3 UFGA9101 SBX POTENTIAL YIELD EXAMPLE;2CV;2SI
4 UFGA9102 SBX CLIMATE CHANGE STUDY EXAMPLE;2CV;ESI
```

EXPERIMENT DETAILS FILE

One main file, referred to as FILEX (Table 3), documents the inputs to the models for each “experiment” to be simulated. Each experiment could be a real one for which there would be corresponding observed field data, or a hypothetical one defined for simulation. Thus, inputs for many real and hypothetical experiments can be stored for documentation and for use at different times. The file heading contains the experiment code and name, the treatment combinations, and details of the experimental conditions (field characteristics, soil analysis data, initial soil water and inorganic nitrogen conditions, seedbed preparation and planting geometries, irrigation and water management, fertilizer management, organic residue applications, chemical applications, tillage operations, environmental modifications, harvest management), and simulation controls. The experiment code uses the same convention as the file naming system to provide information on institute, site, planting year, experiment number, and crop. For example: UFGA8201MZ, is the code for maize experiment 01, planted in 1982 by the institute designated by UF (University of Florida) at site GA (Gainesville). The file can also contain the names of the people supplying the data set and information on the plot sizes, etc., used in the experiment. It may also contain any incidents that occurred during the course of the experiment that may affect the interpretation of the data. These latter items are not normally used by simulations models, but are provided for reference and assistance in interpreting simulation results. Documentation of these sections is included in Table 3, for use when required.

The structure of FILEX has been designed with the goal of maximizing the flexibility of input configurations while preserving the concept of entering only a minimum of inputs to run a simulation. The file can be easily configured to accommodate very different types of simulation runs. To enable this flexibility, the file description provides slots for inputs and descriptive information which may be needed for some types of simulation runs but not for others. FILEX has been configured in such a way that only those data required for individual simulations need be entered.

In order for FILEX to accommodate a wide variety of experimental layouts, a broad definition of what comprises a treatment is necessary. For the purposes of data organization in FILEX, a treatment can be any factor of the experiment which varies. In addition to such things as combinations of fertilizer rates, varieties and irrigation levels, treatments can be different fields or different soils or different soil analyses or different weather. Thus if an experiment compared varieties across locations without water, nutrient and pest limitations, the locations of fields become treatments. This enables one experiment to utilize multiple weather data sets which was not possible when using the IBSNAT v2.1 model inputs and outputs (IBSNAT, 1990).

Most experiments will have more than one treatment. Many experiments will be conducted on only one site with treatments confined to such factors as fertilizer rates, varieties or irrigation treatments. Alternatively, an experiment such as a plant breeding experiment may span several sites where the sites and varieties are treatments. To accommodate these differing possibilities, FILEX has been designed with specific sections dedicated to particular categories of inputs. Only those sections required for the particular simulation need be present in FILEX.

Thus, data for the first treatment of an experiment are entered in the appropriate sections in FILEX. If, however, the experiment has more than one treatment, which is usually the case, then the data which are common to all treatments need not be repeated. This contrasts with the organization of inputs described for previous generations of IBSNAT models (IBSNAT, 1986 and 1990). In this newest version, only those data which are “new” for the treatment need be coded. For example, if an experiment examined the effect of five nitrogen rates, FILEX would contain sections for planting details and initial conditions and a section for fertilizer rate information for the first treatment. For the second treatment, the planting details and initial conditions would not be repeated but a second rate would appear in the fertilizer details section.

The various sections of FILEX are summarized below.

FILE SECTION	TYPICAL CONTENTS
Experiment details	Experiment name and codes
General	Names of people, addresses; name and location of experiment site(s); plot information
Treatments	Treatment number, name and specification of level codes of the treatment factors
Cultivar	Cultivar level, crop code, cultivar ID and name
Fields	Specification of field level, ID, weather station name, soil, and field description details
Soil Analysis	Set of soil properties used for the simulation of nutrient dynamics, based on field nutrient sampling, if any

Initial Conditions	Starting conditions for water and nitrogen in the profile. Also used for carryover of root residue from the previous crop, and N symbiosis initialization details when needed
Planting Details	Planting date, population, seeding depth and row spacing data
Irrigation and Water Management	Irrigation dates, amounts, thresholds and rice flood water depths
Fertilizers	Fertilizer rate, date and type information
Residues	Additions of straw, green manure, animal manure
Chemical Applications	Herbicide and pesticide application data
Environment Modifications	Adjustment factors for weather parameters as used in climate change and constant environment studies (e.g., constant daylength, shading, constant temperature, etc.)
Tillage Information	Details of dates, types of tillage operations
Harvest Details	Information on harvest dates, plant components harvested, etc.
Simulation Controls	Specification of simulation options (e.g., starting dates), on / off options for model components (e.g., water, and nitrogen balances), and output options

It should be noted that for any particular simulation, only a few of these sections would be needed. However, the minimum required information for a simulation (that is, when there are no water, nutrient or pest stresses, and when soil water and nitrogen balances are not used) are the Experiment, Cultivar, Treatment, Field, Planting Details and Simulation Controls sections.

TABLE 3. EXPERIMENT DETAILS FILE. (FILEX)

STRUCTURE

Variable	Variable Name ¹	Header ²	Format ³
Line 1			
*EXP.DETAILS:			0 C 13
Experiment identifier, made up of:			
Institute code	INSTE		1 C 2
Site code	SITEE		0 C 2
Experiment number/abbreviation	EXPTNO		0 C 4
Crop group code	CG		0 C 2
Experiment name ⁴	ENAME ⁴		1 C 60
*GENERAL ⁵			
Line 1(People)			
Names of scientists	PEOPLE	PEOPLE	1 C 75
Line 2 (Address)			
Contact address of principal scientist	ADDRESS	ADDRESS	1 C 75
Line 3 (Sites)			
Name and location of experimental site(s) ⁶	SITE(S) ⁶	SITE(S)	1 C 75
Line 4 (Plot information)			
Gross plot area per rep, m ⁻²	PAREA	PAREA	3 R 6 1
Rows per plot	PRNO	PRNO	1 I 5
Plot length, m	PLEN	PLEN	1 R 5 1
Plots relative to drains, degrees	PLDR	PLDR	1 I 5
Plot spacing, cm	PLSP	PLSP	1 I 5
Plot layout	PLAY	PLAY	1 C 5
Harvest area, m ⁻²	HAREA	HAREA	1 R 5 1
Harvest row number	HRNO	HRNO	1 I 5
Harvest row length, m	HLEN	HLEN	1 R 5 1
Harvest method	HARM	HARM	1 C 15
All other lines (Incidents)			
Notes	NOTES	NOTES	1 C 75
*TREATMENTS			
Treatment number	TRTNO	TN	0 I 2
Rotation component: number (default=1);	ROTNO	R	1 I 1
option (default=1)	ROTOPT	O	1 I 1
Crop component number (default = 0)	CRPNO	C	1 I 1

Treatment name	TITLET	TNAME	1	C	25
Cultivar level	LNCU	CU	1	I	2
Field level	LNFLD	FL	1	I	2
Soil analysis level	LNSA	SA	1	I	2
Initial conditions level	LNIC	IC	1	I	2
Planting level	LNPLT	MP	1	I	2
Irrigation level	LNIR	MI	1	I	2
Fertilizer level	LNFER	MF	1	I	2
Residue level	LNRES	MR	1	I	2
Chemical applications level	LNCHE	MC	1	I	2
Tillage and rotations level	LNTIL	MT	1	I	2
Environmental modifications level	LNENV	ME	1	I	2
Harvest level	LNHAR	MH	1	I	2
Simulation control level	LNSIM	SM	1	I	2
*CULTIVARS					
Cultivar level	LNCU	CU	0	I	2
Crop code	CG	CR	1	C	2
Cultivar identifier (Institute code + Number)	VARNO	INGENO	1	C	6
Cultivar name	CNAME	CNAME	1	C	16
*FIELDS					
Field level	LNFLD	FL	0	I	2
Field ID (Institute + Site + Field)	FLDNAM	ID_FIELD	1	C	8
Weather station code (Institute+Site)	WSTA	WSTA	1	C	8
Slope and aspect, degrees from horizon- tal plus direction (W, NW, etc.)	SLOPE	FLSA	1	C	5
Obstruction to sun, degrees	FLOB	FLOB	1	R	5 0
Drainage type, code ⁷	DFDRN	FLDT	1	C	5
Drain depth, cm	FLDD	FLDD	1	R	5 0
Drain spacing, m	SFDRN	FLDS	1	R	5 0
Surface stones(Abundance,%+Size,S,M,L)	FLST	FLST	1	C	5
Soil texture ⁷	SLTX	SLTX	1	C	5
Soil depth, cm	SLDP	SLDP	1	R	5 0
Soil ID (Institute+Site+Year+Soil)	SLNO	ID_SOIL	1	C	10
*SOIL ANALYSIS					
Line 1					
Soil analysis level	LNSA	SA	0	I	2
Analysis date, year + days from Jan. 1	SADAT	SADAT	1	I	5
pH in buffer determination method, code ⁷	SMHB	SMHB	1	C	5
Phosphorus determination method, code ⁷	SMPX	SMPX	1	C	5
Potassium determination method, code ⁷	SMKE	SMKE	1	C	5

All other lines (L = Layer number)

Soil analysis level	LNSA	SA	0	I	2
Depth, base of layer, cm	SABL(L)	SABL	1	R	5 0
Bulk density, moist, g cm ⁻³	SADM(L)	SADM	1	R	5 1
Organic carbon, g kg ⁻¹	SAOC(L)	SAOC	1	R	5 2
Total nitrogen, g kg ⁻¹	SANI(L)	SANI	1	R	5 2
pH in water	SAPHW(L)	SAHW	1	R	5 1
pH in buffer	SAPHB(L)	SAHB	1	R	5 1
Phosphorus, extractable, mg kg ⁻¹	SAPX(L)	SAEX	1	R	5 1
Potassium, exchangeable, cmol kg ⁻¹	SAKE(L)	SAKE	1	R	5 1

***INITIAL CONDITIONS**

Line 1

Initial conditions level	LNIC	IC	0	I	2
Previous crop code	PRCROP	PCR	1	C	5
Initial conditions measurement date, year + days	IDAYIC	ICDAT	1	I	5
Root weight from previous crop, kg ha ⁻¹	WRESR	ICRT	1	R	5 0
Nodule weight from previous crop, kg ha ⁻¹	WRESND	ICND	1	R	5 0
Rhizobia number, 0 to 1 scale (default = 1)	EFINOC	ICRN	1	R	5 2
Rhizobia effectiveness, 0 to 1 scale (default = 1)	EFNFIK	ICRE	1	R	5 2

All other lines (L = Layer number)

Initial conditions level	LNIC	IC	0	I	2
Depth, base of layer, cm	DLAYRI(L)	ICBL	1	R	5 0
Water, cm ³ cm ⁻³ x 100 volume percent	SWINIT(L)	SH20	1	R	5 3
Ammonium, KCl, g elemental N Mg ⁻¹ soil	INH4(L)	SNH4	1	R	5
Nitrate, KCl, g elemental N Mg ⁻¹ soil	IN03(L)	SN03	1	R	5 1

***PLANTING DETAILS**

Planting level number	LNPLT	MP	0	I	2
Planting date, year + days from Jan. 1	YRPLT	PDATE	1	I	5
Emergence date, earliest treatment	IEMRG	EDATE	1	I	5
Plant population at seeding, plants m ⁻²	PLANTS	PPOP	1	R	5 1
Plant population at emergence, plants m ⁻²	PLTPOP	PPOE	1	R	5 1
Planting method, transplant (T), seed (S), pregerminated seed (P) or nursery (N)	PLME	PLME	5	C	1
Planting distribution, row (R), broadcast (B) or hill (H)	PLDS	PLDS	5	C	1
Row spacing, cm	ROWSPC	PLRS	1	R	5 0
Row direction, degrees from N	AZIR	PLRD	1	R	5 0
Planting depth, cm	SDEPTH	PLDP	1	R	5 1

Planting material dry weight, kg ha ⁻¹	SDWTPL	PLWT	1	R	5	0
Transplant age, days	SDAGE	PAGE	1	R	5	0
Temp. of transplant environment, °C	ATEMP	PENV	1	R	5	1
Plants per hill (if appropriate)	PLPH	PLPH	1	R	5	1

***IRRIGATION AND WATER MANAGEMENT**

Line 1

Irrigation level	LNIR	MI	0	I	2	
Irrigation application efficiency, fraction	EFFIRX	EFIR	1	R	5	2
Management depth for automatic application, cm	DSOILX	IDEP	1	R	5	0
Threshold for automatic appl., % of max. available	THETCX	ITHR	1	R	5	0
End point for automatic appl., % of max. available	IEPTX	IEPT	1	R	5	0
End of applications, growth stage	IOFFX	IOFF	1	C	5	
Method for automatic applications, code ⁵	IAMEX	IAME	1	C	5	
Amount per irrigation if fixed, mm	AIRAMX	IAMT	1	R	5	0

All other lines (J = Irrigation application number)

Irrigation level	LNIR	MI	0	I	2	
Irrigation date, year + day or days from planting	IDLAPL(J)	IDATE	1	I	5	
Irrigation operation, code ⁷	IRRCOD(J)	IROP	1	C	5	
Irrigation amount, depth of water/water table, bund height, or percolation rate, mm or mm day ⁻¹	AMT(J)	IRVAL	1	R	5	0

***FERTILIZERS (INORGANIC) (J = Fertilizer application number)**

Fertilizer application level	LNFERT	MF	0	I	2	
Fertilization date, year + day or days from planting	FDAY(J)	FDATE	1	I	5	
Fertilizer material, code ⁷	IFTYPE(J)	FMCD	1	C	5	
Fertilizer application/placement, code ⁷	FERCOD(J)	FACD	1	C	5	
Fertilizer incorporation/application depth, cm	DFERT(J)	FDEP	1	R	5	0
N in applied fertilizer, kg ha ⁻¹	ANFER(J)	FAMN	1	R	5	0
P in applied fertilizer, kg ha ⁻¹	APFER(J)	FAMP	1	R	5	0
K in applied fertilizer, kg ha ⁻¹	AKFER(J)	FAMK	1	R	5	0
Ca in applied fertilizer, kg ha ⁻¹	ACFER(J)	FAMC	1	R	5	0
Other elements in applied fertilizer, kg ha ⁻¹	AOFER(J)	FAMO	1	R	5	0
Other element code, e.g., . MG	FOCOD(J)	FOCD	1	C	5	

*RESIDUES AND OTHER ORGANIC MATERIALS (J = Residue application number)				
Residue management level	LNRES	MR	0	I 2
Incorporation date, year + days	RESDAY(J)	RDATE	1	I 5
Residue material, code ⁷	RESCOD(J)	RCOD	1	C 5
Residue amount, kg ha ⁻¹	RESIDUE(J)	RAMT	1	R 5 0
Residue nitrogen concentration, %	RESN(J)	RESN	1	R 5 2
Residue phosphorus concentration, %	RESP(J)	RESP	1	R 5 2
Residue potassium concentration, %	RESK(J)	RESK	1	R 5 2
Residue incorporation percentage, %	RINP(J)	RINP	1	R 5 0
Residue incorporation depth, cm	DEPRES(J)	RDEP	1	R 5 0
*CHEMICAL APPLICATIONS (J = Chemical application number)				
Chemical applications level	LNCH	MC	0	I 2
Application date, year + day or days from planting	CDATE(J)	CDATE	1	I 5
Chemical material, code ⁷	CHCOD(J)	CHCOD	1	C 5
Chemical application amount, kg ha ⁻¹	CHAMT(J)	CHAMT	1	R 5 2
Chemical application method, code	CHMET(J)	CHME	1	C 5
Chemical application depth, cm	CHDEP(J)	CHDEP	1	C 5
Chemical targets	CHT	CHT	1	C 5
*TILLAGE (J = Tillage application number)				
Tillage level	TL	TL	0	I 2
Tillage date, year + day	TDATE(J)	TDATE	1	I 5
Tillage implement, code ⁷	TIMPL(J)	TIMPL	1	C 5
Tillage depth, cm	TDEP(J)	TDEP	1	R 5 0
*ENVIRONMENT MODIFICATIONS (J = Environment modification number)				
Environment modifications level	LNENV	ME	0	I 2
Modification date, year + day or days from planting	WMDATE(J)	ODATE	1	I 5
Daylength adjustment factor (A,S,M,R)	DAYFAC(J)	E	1	C 1
Daylength adjustment, h	DAYADJ(J)	DAY	0	R 4 1
Radiation adjustment factor (A,S,M,R)	RADFAC(J)	E	1	C 1
Radiation adjustment, MJ m ⁻² d ⁻¹	RADADJ(J)	RAD	0	R 4 1
Temperature (maximum) adjustment factor (A,S,M,R)	TXFAC(J)	E	1	C 1
Temperature (maximum) adjustment, °C	TXADJ(J)	MAX	0	R 4 1
Temperature (minimum) adjustment factor (A,S,M,R)	TMFAC(J)	E	1	C 1
Temperature (minimum) adjustment, °C	TMADJ(J)	MIN	0	R 4 1
Precipitation adjustment factor (A,S,M,R)	PRCFAC(J)	E	1	C 1
Precipitation adjustment, mm	PRCADJ(J)	RAIN	0	R 4 1
CO ₂ adjustment code (A,S,M,R)	CO2FAC(J)	E	1	C 1
CO ₂ adjustment, vpm	CO2ADJ(J)	CO2	0	R 4 0
Humidity adjustment factor (A,S,M,R)	DPTFAC(J)	E	1	C 1
Humidity (dew pt) adjustment, °C	DPTADJ(J)	DEW	0	R 4 1

Wind adjustment factor (A,S,M,R)	WPDFAC(J)	E	1	C	1
Wind adjustment, km day ⁻¹	WPDADJ(J)	WIND	0	R	4 1
N.B. A = add, S = subtract, M = multiply, R = replace					
*HARVEST DETAILS (J = Harvest number)					
Harvest level	LNHAR	HL	0	I	2
Harvest date, year + day or days from planting	HDATE(J)	HDATE	1	I	5
Harvest stage	HSTG(J)	HSTG	1	C	5
Harvest component, code ⁷	HCOM(J)	HCOM	1	C	5
Harvest size group, code ⁷	HSIZ(J)	HSIZ	1	C	5
Harvest percentage, %	HPC(J)	HPC	1	R	5 0

¹ Abbreviations used as variable names in the IBSNAT models.

² Abbreviations suggested for use in header lines (those designated with '@') within the file.

³ Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.

⁴ It is suggested that Experiment Name be composed of a short name, followed by a blank space, summary of treatment factors, followed by a blank space, and end with a local abbreviation for the experiment in parenthesis. This information will then be available for searching and organizing experiments, using the list managers described in Volume 1-3 (Hunt et al. 1994) of this book.

⁵ Each section in the actual file needs a heading of this type.

⁶ It is suggested that the SITE information on data line 3 be composed of a short site name, followed by a blank space, then latitude, longitude, elevation (in meters above sea level, and climate zone, each separated by a semi-colon. For example:

GAINESVILLE,FL 29.63N;82.37W;40M;SEUSA

⁷ For a complete listing of these codes, see Appendix B.

TREATMENT LEVEL INDICATORS

A system of pointers or treatment level indicators reduces the amount of data contained in FILEX. These level indicators are used to specify the combinations of inputs for each treatment. They flag the models as to which sections of FILEX are needed for the simulation. Within each flagged section, the indicators point to the data relevant to the chosen treatment.

The level indicators in the order in which they appear in FILEX, together with their abbreviations are shown below:

Cultivar Level	CU
Field Level	FL
Soil Analysis Level	SA
Initial Conditions Level	IC
Planting Level	MP
Irrigation Level	MI
Fertilizer Level	MF
Residue Level	MR
Chemical applications Level	MC
Tillage And Rotations Level	MT
Environmental Modification Level	ME
Harvest Level	MH
Simulation Control Level	SM

As an example, consider an experiment with 3 N rates and 2 irrigation management levels. In this experiment, the cultivar, field details, initial conditions and residue management remain the same for all treatments. Assuming planting details and required simulation options are also the same for both treatments and there is no consideration given to chemical, tillage and environmental modification, then the treatment section of FILEX and the corresponding level indicators would appear as below. Note how the level indicators for water and fertilizer vary with treatments.

*TREATMENTS

@N	R	O	C	TNAME	CU	FL	SA	IC	MP	MI	MF	MR	MC	MT	ME	MH	SM
01	1	1	0	0 N LOW WATER	1	1	0	1	1	1	1	1	0	0	0	0	1
02	1	1	0	30 N LOW WATER	1	1	0	1	1	1	2	1	0	0	0	0	1
03	1	1	0	90 N LOW WATER	1	1	0	1	1	1	3	1	0	0	0	0	1
04	1	1	0	0 N HI WATER	1	1	0	1	1	2	1	1	0	0	0	0	1
05	1	1	0	30 N HI WATER	1	1	0	1	1	2	2	1	0	0	0	0	1
06	1	1	0	90 N HI WATER	1	1	0	1	1	2	3	1	0	0	0	0	1

From the data depicted here, the model will discern that it must locate data in the cultivar (CU), field (FL), initial conditions (IC), planting (MP), irrigation (MI), fertilizers (MF), residue (MR) and simulation control (SM) sections of FILEX. The zeros for soil analysis (SA), chemical (MC), tillage (MT), environment (ME), and harvest (MH) indicate that no data are required for these sections. In treatment one, the irrigation data to be used would be those appearing first in the irrigation section. The fertilizer data for treatment one would be those appearing first in the fertilizer section. For the second treatment the same irrigation data are used but the second set of fertilizer data from the fertilizer section is used. For the fourth treatment, the second irrigation data set and the first fertilizer data set are used.

Details of all sections of FILEX are provided in Table 3. It should also be noted that not all entries within a particular section are required for all simulations. To facilitate construction of a typical FILEX, various examples are provided in the “Examples” section below.

SIMULATION CONTROL INFORMATION

The Simulation Controls section (see Table 4) in FILEX has two basic functions. First, it specifies the options to be used in a particular simulation run and controls the types and frequencies of outputs to be obtained. An OPTIONS line specifies whether the water and nitrogen balances will be used and whether pest damage will be considered in the run. The METHODS line specifies the methods for computing processes such as evapotranspiration and photosynthesis. The MANAGEMENT line specifies whether different management operations, such as planting and irrigation, are to be based on recorded data as input in the FILEX or are to be simulated internally based on automatic management options specified in this section. The OUTPUTS line specifies the frequency of daily outputs and the types of outputs to write (such as summary, growth, water, nitrogen and pest). Since there are no default selections for the variables contained under Methods, Management and Outputs, selections for these variables *must* be made.

The second function of the Simulation Control section is to specify the parameters for controlling automatic management in the simulation (if any are used) for planting, irrigating, applying nitrogen and residues, and harvesting. For example, information on the “sowing” and “harvesting” windows for use with hypothetical experiments, as well as the soil water threshold that triggers automatic application and the depth of water management, are contained in this section.

One Simulation Control section is required for each FILEX, and more than one could be used to control simulation for different treatments if needed.

Light interception	MELI	LIGHT	5	C	1
E = Exponential with LAI					
H = 'Hedgerow' calculations					
Evaporation	MEEVP	EVAP0	5	C	1
P = FAO - Penman					
R = Ritchie modification of Priestley-Taylor					
Infiltration	MEINF	INFIL	5	C	1
R = Ritchie method					
S = Soil Conservation Service routines					
Photosynthesis	MEPHO	PHOTO	5	C	1
C = Canopy photosynthesis response curve					
R = Radiation use efficiency					
L = Leaf photosynthesis response curve					
Line 4: Management					
Level number	LNSIM	N	0	I	2
Identifier	TITMAT	MANAGEMENT	1	C	11
Planting/Transplanting	IPLTI	PLANT	5	C	1
A = Automatic when conditions satisfactory					
R = On reported date					
Irrigation and Water Management	IIRRI	IRRIG	5	C	1
A = Automatic when required					
N = Not irrigated					
F = Automatic with fixed amounts at each irrigation date					
R = On reported dates					
D = As reported, in days after planting					
Fertilization	IFERI	FERTI	5	C	1
A = Automatic when required					
N = Not fertilized					
F = Automatic with fixed amounts at each fertilization date					
R = On reported dates					
D = As reported, in days after planting					
Residue applications	IRESI	RESID	5	C	1
A = Automatic for multiple years/crop sequences					
N = No applications					
F = Automatic with fixed amounts at each residue application date					
R = On reported dates					
D = As reported, in days after planting					
Harvest	IHARI	HARVS	5	C	1
A = Automatic when conditions satisfactory					
G = At reported growth stage(s)					
M = At maturity					
R = On reported date(s)					
D = On reported days after planting					

Line 5: Outputs

Level number	LNSIM	N	0	I	2
Identifier	TITOUT	OUTPUTS	1	C	11
Experiment (Y = yes, files named with the experiment code; N = no)	IOX	FNAME	5	C	1
General (Y = yes, new; A = append; N = no)					
Overview	IDETO	OVVEW	5	C	1
Summary	IDETS	SUMRY	5	C	1
Details - individual aspects					
Frequency of output (days)	FROP	FROPT	4	I	2
Growth (Y = yes; N = no)	IDETG	GROUT	5	C	1
Carbon (Y = yes; N = no)	IDETC	CAOUT	5	C	1
Water (Y = yes; N = no)	IDETW	WAOUT	5	C	1
Nitrogen (Y = yes; N = no)	IDETN	NIOUT	5	C	1
Phosphorous (Y = yes; N = no)	IDETP	MIOUT	5	C	1
Diseases and other pests (Y = yes; N = no)	IDETD	DIOUT	5	C	1
Wide (Y) or 80-column (N) daily outputs	IDETL	LONG	5	C	1

Other lines

These deal separately with different aspects of automatic management. They are only necessary if automatic management is called for.

Planting:

Level number	LNSIM	N	0	I	2
Identifier	TITPLA	PLANTING	1	C	11
Earliest, year and day of year (YRDOY)	PWDINF	PFRST	1	I	5
Latest, year and day of year (YRDOY)	PWDINL	PLAST	1	I	5
Lowermost soil water, %	SWPLTL	PH20L	1	R	5 0
Uppermost soil water, %	SWPLTH	PH20U	1	R	5 0
Management depth for water, cm	SWPLTD	PH20D	1	R	5 0
Max. soil temp. (10 cm av.), °C	PTX	PSTMX	1	R	5 0
Min. soil temp. (10 cm av.), °C	PTTN	PSTMN	1	R	5 0

Irrigation and Water Management:

Level number	LNSIM	N	0	I	2
Identifier	TITIRR	IRRIGATION	1	C	11
Management depth, cm	DSOIL	IMDEP	1	R	5 0
Threshold, % of maximum available	THETAC	ITHRL	1	R	5 0
End point, % of maximum available	IEPT	ITHRU	1	R	5 0
End of applications, growth stage	IOFF	IROFF	1	C	5
Method, code	IAME	IMETH	1	C	5
Amount per irrigation, if fixed, mm	AIRAMT	IRAMT	1	R	5 0
Irrigation application efficiency, fraction	EFFIRR	IREFF	1	R	5 2

Nitrogen Fertilization:

Level number	LNSIM	N	0	I	2
Identifier	TITNIT	NITROGEN	1	C	11
Application depth, cm	DSOILN	NMDEP	1	R	5 0
Threshold, N stress factor, %	SOILNC	NMTHR	1	R	5 0
Amount per application, kg N ha ⁻¹	SOILNX	NAMNT	1	R	5 0
Material, code	NCODE	NCODE	1	C	5
End of applications, growth stage	NEND	NAOFF	1	C	5

Residues:

Level number	LNSIM	N	0	I	2
Identifier	TITRES	RESIDUES	1	C	11
Incorporation percentage, % of remaining	RIP	RIPCN	1	R	5 0
Incorporation time, days after harvest	NRESDL	RTIME	1	I	5
Incorporation depth, cm	DRESMG	RIDEP	1	R	5 0

Harvests:

Level number	LNSIM	N	0	I	2
Identifier	TITHAR	HARVESTS	1	C	11
Earliest, days after maturity	HDLAY	HFRST	1	I	5
Latest, year and day of year (YRDOY)	HLATE	HLAST	1	I	5
Percentage of product harvested, %	HPP	HPCNP	1	R	5 0
Percentage of residue harvested, %	HRP	HRCNR	1	R	5 0

¹ Abbreviations used as variable names in the IBSNAT models.

² Abbreviations suggested for use in header lines (those designated with '@') within the file.

³ Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.

EXAMPLES OF FILEX FOR VARIOUS EXPERIMENTS

The examples chosen below commence with the most simple experiment where only a minimum set of data are required and end with a soil fertility simulation experiment where the simulation models require considerably more data.

EXPERIMENT 1 (POTENTIAL YIELD)

Users may wish to examine the impact of weather on crop duration and yield potential of two varieties of soybean at two sites with no water, nutrient or pest constraints. For this experiment the only data required in FILEX are the experiment and treatment titles and codes for the variety, soil, a weather data set, planting data and simulation controls. The codes for variety and soil must also be contained in the cultivar and soil files, respectively, so that crop models can obtain the genetic coefficients for the planted variety and the soil inputs for the soil in which the crop was grown. The file name for weather data is required, e.g., UFGA8801.WTH. Alternately, the code for weather data can be specified to construct a file name which contains daily weather data in the DSSAT v3 crop models, e.g., the code UFGA for the weather station would result in the file name of UFGA8801.WTH if the experiment were planted in 1988. An example FILEX for this experiment is given in Table 5 and the required data are highlighted. Note the default settings used in the Simulation Controls section.

TABLE 5. EXAMPLE FILEX FOR A POTENTIAL YIELD EXPERIMENT IN WHICH THERE ARE TWO VARIETIES OF SOYBEAN GROWN IN TWO LOCATIONS. THE FILE NAME FOR STORING THIS EXPERIMENT INFORMATION WOULD BE UFGA9101.SBX.

*EXP.DETAILS: UFGA9101SB SOYBEAN POTENTIAL YIELD, 2 VARIETIES, 2 SITES (EXAMPLE)

*GENERAL

@PEOPLE

A. B. HOWART AND K. T. BARTH

@ADDRESS

DEPARTMENT OF AGRONOMY, THE UNIVERSITY OF FLORIDA

@SITE

GAINESVILLE, FLORIDA, AND HONOLULU, HAWAII

@ PAREA PRNO PLEN PLDR PLSP PLAY HAREA HRNO HLEN HARM.....

30.0 4 15.0 0 50 N-S 10.0 10 2.0 Hand Harvest

@NOTES

Example experiment with 2 varieties at 2 locations. BRAGG and COBB soybeans are planted at Gainesville, Florida in field UFGA0001, weather station UFGA and soil UFGA9101, and planted at Honolulu, Hawaii, in field IBUH0001, weather station IBUH in soil IBUH8801

*TREATMENTS

-----FACTOR LEVELS-----

@N	R	O	C	TNAME.....	CU	FL	SA	IC	MP	MI	MF	MR	MC	MT	ME	MH	SM
1	1	0	0	BRAGG AT GAINESVILLE	1	1	0	0	1	0	0	0	0	0	0	0	1
2	1	0	0	BRAGG AT HAWAII	1	2	0	0	1	0	0	0	0	0	0	0	1
3	1	0	0	COBB AT GAINESVILLE	2	1	0	0	1	0	0	0	0	0	0	0	1
4	1	0	0	COBB AT HAWAII	2	2	0	0	1	0	0	0	0	0	0	0	1

*CULTIVARS

@C CR INGENO CNAME

1 SB UF0001 BRAGG

2 SB UF0002 COBB

*FIELDS

@L	ID_FIELD	WSTA....	FLSA	FLOB	FLDT	FLDD	FLDS	FLST	SLTX	SLDP	ID_SOIL
1	UFGA0001	UFGA	90-N	0	DR001	0	0	0	SA	180	UFGA9101
2	IBUH0001	IBUH	30-N	0	DR001	0	0	0	SALO	200	IBUH8801

*PLANTING DETAILS

@P	PDATE	EDATE	PPOP	PPOE	PLME	PLDS	PLRS	PLRD	PLDP	PLWT	PAGE	PENV	PLPH
1	91177		30.0	30.0	S	R	75	0	4.0	-99	-99	-99.0	-99.0

```

*SIMULATION CONTROLS
@N GENERAL      NYERS NREPS START SDATE RSEED SNAME.....
1              1      1      S 91177 2150 POTENTIAL YIELD
@N OPTIONS      WATER NITRO SYMBI PHOSP POTAS DISES
1              N      N      N      N      N      N
@N METHODS      WTHER INCON LIGHT EVAPO INFIL PHOTO
1              M      M      E      R      S      C
@N MANAGEMENT   PLANT IRRIG FERTI RESID HARVS
1              R      N      N      N      M
@N OUTPUTS      XCODE OVVEW SUMRY FROPT GROTH CARBN WATER NITRO MINER DISES LONG
1              N      Y      Y      3      Y      N      N      N      N      N      N

@ AUTOMATIC MANAGEMENT
@N PLANTING      PFRST PLAST PH20L PH20U PH20D PSTMX PSTMN
1              155    200    40    100    30    40    10
@N IRRIGATION    IMDEP ITHRL ITHRU IROFF IMETH IRAMT IREFF
1              30     50    100 GS000 IR001 10 1.00
@N NITROGEN      NMDEP NMTHR NAMNT NCODE NAOFF
1              30     50    25 FE001 GS000
@N RESIDUES      RIPCN RTIME RIDEP
1              100    1     20
@N HARVEST       HFRST HLAST HPCNP HPCNR
1              0     365  100    0
    
```

EXPERIMENT 2 (CLIMATE CHANGE STUDY)

If users wish to determine the effects of a 4°C temperature increase on yield of the crops in Experiment 1 described above, a section on Environmental Modification would be added to FILEX. As shown in Table 6, which illustrates an example FILEX for this experiment, the same 4 treatments from Experiment 1 are included, then 4 additional treatments are specified with the Environmental Modification level set to 1 under the Factor Levels in the Treatments section. In the Environmental Modification section, an entry is made to specify that 4°C is added to both daily minimum and maximum temperatures starting on the day of planting. In this hypothetical experiment, which is to be simulated, there are still no water, nutrient or pest stresses, and the soil water and nitrogen balances are still not used. The settings for the Simulation Controls section remain the same as those given in the example FILEX for “Experiment 1” (Table 5).

TABLE 6. EXAMPLE FILEX FOR A CLIMATE CHANGE EXPERIMENT IN WHICH MAXIMUM AND MINIMUM DAILY TEMPERATURE ARE RAISED 4 °C, AND THERE ARE 2 VARIETIES OF SOYBEAN GROWN IN TWO LOCATIONS. THE FILE NAME FOR STORING THIS EXPERIMENT INFORMATION WOULD BE UFGA9102.SBX.

*EXP.DETAILS: UFGA9102SB SOYBEAN CLIMATE CHANGE : 2 VARIETIES, 2 SITES (EXAMPLE2)

*GENERAL

@PEOPLE

A. B. HOWART AND K. T. BARTH

@ADDRESS

DEPARTMENT OF AGRONOMY, THE UNIVERSITY OF FLORIDA

@SITE

GAINESVILLE, FLORIDA, AND HONOLULU, HAWAII

@ PAREA PRNO PLEN PLDR PLSP PLAY HAREA HRNO HLEN HARM.....

30.0 4 15.0 0 50 N-S 10.0 10 2.0 Hand Harvest

@NOTES

This is a climate change experiment with 2 varieties at 2 locations
Varieties BRAGG and COBB are planted at Gainesville, Florida in field
UFGA0001, weather station site UFGA and soil UFGA9101, and at Honolulu,
Hawaii, in field IBUH0001, weather station site IBUH in soil IBUH8801.
Max. and Min. temperature are increased at 4C.

*TREATMENTS

-----FACTOR LEVELS-----

@N	R	O	C	TNAME.....	CU	FL	SA	IC	MP	MI	MF	MR	MC	MT	ME	MH	SM
1	1	0	0	BRAGG AT GAINESVILLE	1	1	0	0	1	0	0	0	0	0	0	0	1
2	1	0	0	BRAGG AT HAWAII	1	2	0	0	1	0	0	0	0	0	0	0	1
3	1	0	0	COBB AT GAINESVILLE	2	1	0	0	1	0	0	0	0	0	0	0	1
4	1	0	0	COBB AT HAWAII	2	2	0	0	1	0	0	0	0	0	0	0	1
5	1	0	0	+4 C, BRAGG AT GAINESVILL	1	1	0	0	1	0	0	0	0	0	1	0	1
6	1	0	0	+4 C, BRAGG AT HAWAII	1	2	0	0	1	0	0	0	0	0	1	0	1
7	1	0	0	+4 C, COBB AT GAINESVILLE	2	1	0	0	1	0	0	0	0	0	1	0	1
8	1	0	0	+4 C, COBB AT HAWAII	2	2	0	0	1	0	0	0	0	0	1	0	1

*CULTIVARS

@C CR INGENO CNAME

1 SB UF0001 BRAGG

2 SB UF0002 COBB

*FIELDS

@L	ID_FIELD	WSTA....	FLSA	FLOB	FLDT	FLDD	FLDS	FLST	SLTX	SLDP	ID_SOIL
1	UFGA0001	UFGA	90-N	0	DR001	0	0	0	SA	180	UFGA9101
2	IBUH0001	IBUH	30-N	0	DR001	0	0	0	SALO	200	IBUH8801

*PLANTING DETAILS

@P	PDATE	EDATE	PPOP	PPOE	PLME	PLDS	PLRS	PLRD	PLDP	PLWT	PAGE	PENV	PLPH
1	91177		30.0	30.0	S	R	75	0	4.0	-99	-99	-99.0	-99.0

*ENVIRONMENTAL MODIFICATIONS

@E	ODATE	EDAY	ERAD	EMAX	EMIN	ERAIN	ECO2	EDEW	EWIND
1	91177	A	0.0	A	0.0	A	4.0	A	0.0
				A	4.0	A	0.0	A	0.0

*SIMULATION CONTROLS

@N	GENERAL	NYERS	NREPS	START	SDATE	RSEED	SNAME							
1		1	1	S	91177	2150	CLIMATE CHANGE SIMULATION							
@N	OPTIONS	WATER	NITRO	SYMBI	PHOSP	POTAS	DISES							
1		N	N	N	N	N	N							
@N	METHODS	WTHR	INCON	LIGHT	EVAPO	INFIL	PHOTO							
1		M	M	E	R	S	C							
@N	MANAGEMENT	PLANT	IRRIG	FERTI	RESID	HARVS								
1		R	N	N	N	M								
@N	OUTPUTS	FNAME	OVVEW	SUMRY	FROPT	GROUT	CAOUT	WAOUT	NIOUT	MIOUT	DIOUT	LONG		
1		N	Y	Y	3	Y	N	N	N	N	N	N		

@ AUTOMATIC MANAGEMENT

@N	PLANTING	PFRST	PLAST	PH20L	PH20U	PH20D	PSTMX	PSTMN
1		155	200	40	100	30	40	10
@N	IRRIGATION	IMDEP	ITHRL	ITHRU	IROFF	IMETH	IRAMT	IREFF
1		30	50	100	GS000	IR001	10	1.00
@N	NITROGEN	NMDEP	NMTHR	NAMNT	NCODE	NAOFF		
1		30	50	25	FE001	GS000		
@N	RESIDUES	RIPCEN	RTIME	RIDEP				
1		100	1	20				
@N	HARVEST	HFRST	HLAST	HPCNP	HPCNR			
1		0	365	100	0			

EXPERIMENT 3 (IRRIGATION STUDIES)

In this example, one variety of maize is planted on 2 different dates, with and without irrigation in a factorial arrangement. Table 7 shows the corresponding example FILEX with the 4 treatments. Note that there are 2 entries in the Planting section and 2 entries in the Irrigation section since the date for the second planting is different from that of the first planting. Also in this example, there is an Initial Conditions section with initial values of soil water. The “-99” values in the initial NO₃ and NH₄ columns indicate that initial values of soil nitrogen were not taken. Because the soil nitrogen balance is switched off in the Simulation Controls section, this will not affect results. Also note that the water balance is switched on in the Simulation Controls section as indicated by the “Y” under WATER in Options, and that the switch for irrigation management in the Simulation Controls section is “R” under IRRIG in Management, which means that reported field data are to be used in the simulation. Output controls specify that the overview, summary, daily growth, and daily water outputs are to be produced with 3 day intervals.

TABLE 7. EXAMPLE FILEX FOR A MAIZE IRRIGATION EXPERIMENT. THE FILE NAME FOR STORING THIS EXPERIMENT INFORMATION WOULD BE UFGA8101.MZX.

*EXP.DETAILS: UFGA8101MZ MAIZE EXPERIMENT, IRR. AND NON-IRR. (EXAMPLE3)

*GENERAL

@PEOPLE

DR. J. BENNETT

@ADDRESS

GAINESVILLE, FLORIDA

@SITE

GAINESVILLE, FL 29.63N;82.37W;40M;SE-USA

@ PAREA PRNO PLEN PLDR PLSP PLAY HAREA HRNO HLEN HARM.....

30.0 4 15.0 0 50 N-S 10.0 10 2.0 Hand harvest

@NOTES

This is a maize irrigation experiment, conducted at Gainesville, Florida, using the variety Pioneer 304C with 4 treatments :
2 irrigation levels and 2 planting dates

*TREATMENTS

-----FACTOR LEVELS-----

@N	R	O	C	TNAME.....	CU	FL	SA	IC	MP	MI	MF	MR	MC	MT	ME	MH	SM
1	1	0	0	IRRIG, PL-DAY 177 PI304C	1	1	0	1	1	1	0	0	0	0	0	0	1
2	1	0	0	NON-IRR, PL-DAY 177, PI0304	1	1	0	1	1	0	0	0	0	0	0	0	1
3	1	0	0	IRRIG, PL-DAY 195 PI304C	1	1	0	2	2	2	0	0	0	0	0	0	1
4	1	0	0	NON-IRR, PL-DAY 195, PI030	1	1	0	2	2	0	0	0	0	0	0	0	1

*CULTIVARS

@C CR INGENO CNAME

1 MZ UF0001 PI304C

*FIELDS

@L	ID_FIELD	WSTA....	FLSA	FLOB	FLDT	FLDD	FLDS	FLST	SLTX	SLDP	ID_SOIL
1	UFGA0001	UFGA	90-N	0	DR001	0	0	0	LOSA	180	UFGA7701

*INITIAL CONDITIONS

@C	PCR	ICDAT	ICRT	ICND	ICRN	ICRE
1	SB	81177	100	0	1.00	1.00

@C	ICBL	SH20	SNH4	SN03
1	5	0.086	-99.0	-99.0
1	15	0.086	-99.0	-99.0
1	30	0.086	-99.0	-99.0
1	45	0.086	-99.0	-99.0
1	60	0.086	-99.0	-99.0
1	90	0.076	-99.0	-99.0
1	120	0.076	-99.0	-99.0
1	150	0.130	-99.0	-99.0
1	180	0.258	-99.0	-99.0

```

@  AUTOMATIC MANAGEMENT
@N PLANTING      PFRST PLAST PH20L PH20U PH20D PSTMX PSTMN
  1              155   200   40   100   30   40   10
@N IRRIGATION    IMDEP ITHRL ITHRU IROFF IMETH IRAMT IREFF
  1              30    50   100 GS000 IR001   10  1.00
@N NITROGEN      NMDEP NMTHR NAMNT NCODE NAOFF
  1              30    50   25 FE001 GS000
@N RESIDUES      RIPCN RTIME RIDEP
  1              100     1    20
@N HARVEST       HFRST HLAST HPCNP HPCNR
  1              0    365   100    0
    
```

EXPERIMENT 4 (FERTILIZER AND IRRIGATION STUDIES)

In this final example, a maize crop is to be grown with and without irrigation, and with 3 N fertilizer amounts (0, 50, and 100 kg N/ha). In Table 8, the example FILEX shows that Fertilizer and Residue sections have been added. The Residue section has only one entry, which means that all treatments had the same residue management history. In the Fertilizer section, there are 2 entries to specify the 50 and 100 kg N/ha application levels. An entry was not required for the 0 kg N/ha. Treatments 2, 4, and 6 were not irrigated, as indicated by the 0's in the MI column, and treatments 1, 3, and 5 all had the same irrigation schedule. For example, Treatment 5 had 50 kg N/ha applied and was irrigated 5 times. In the Simulation Controls section, the water and nitrogen balances were both turned on as indicated by the "Y" under WATER and NITRO in Options. This example does not show a Soil Analysis section, since soil samples were collected from the field for organic carbon, phosphorus, etc., and used to replace the values in the soil file which may have been collected from another site. In this example, recorded data were selected in the Simulation Controls section in Management as shown by the irrigation section switched to "R" under IRRIG. If no irrigation data are available, then the user can select the simulated irrigation management option ("A" or "R") which are both automatic. If the automatic ("A") option for fertilizer or irrigation is specified in Management in the Simulation Controls section, then the model determines when management applications for these are made. In that case, the user should specify the set points on when and how much irrigation and/or fertilizer are applied and the method used to apply them.

TABLE 8. EXAMPLE FILEX FOR A MAIZE IRRIGATION AND NITROGEN LEVEL EXPERIMENT. THE FILE NAME FOR STORING THIS EXPERIMENT INFORMATION WOULD BE UFGA8102.MZX.

*EXP.DETAILS: UFGA8102MZ MAIZE EXPERIMENT, IRR. AND NITROGEN (EXAMPLE4)

*GENERAL

@PEOPLE

DR. K. J. BOOTE

@ADDRESS

DEPARTMENT OF AGRONOMY, UNIV. OF FLORIDA, GAINESVILLE

@SITE

IRRIGATION PARK, GAINESVILLE, FLORIDA 29.63N;82.37W;40M;SE-USA

@ PAREA PRNO PLEN PLDR PLSP PLAY HAREA HRNO HLEN HARM.....

60.0 6 10.0 0 100 N-S 20.0 10 2.0 Hand harvest

@NOTES

This is a maize irrigation experiment, conducted at Gainesville, Florida, using the variety Pioneer 304C with 4 treatments :

2 irrigation levels and 2 planting dates

*TREATMENTS

-----FACTOR LEVELS-----

@N	R	O	C	TNAME.....	CU	FL	SA	IC	MP	MI	MF	MR	MC	MT	ME	MH	SM
1	1	0	0	IRRIG, 0 N	1	1	0	1	1	1	0	1	0	0	0	0	1
2	1	0	0	NON-IRRIG, 0 N	1	1	0	1	1	0	0	1	0	0	0	0	1
3	1	0	0	IRRIG, 50 KG/HA N	1	1	0	1	1	1	1	1	0	0	0	0	1
4	1	0	0	NON-IRRIG, 50 KG/HA	1	1	0	1	1	0	1	1	0	0	0	0	1
5	1	0	0	IRRIG, 100 KG/HA	1	1	0	1	1	1	2	1	0	0	0	0	1
6	1	0	0	NON-IRRIG, 100 KG/HA	1	1	0	1	1	0	2	1	0	0	0	0	1

*CULTIVARS

@C CR INGENO CNAME

1 MZ UF0001 PI304C

*FIELDS

@L	ID_FIELD	WSTA....	FLSA	FLOB	FLDT	FLDD	FLDS	FLST	SLTX	SLDP	ID_SOIL
1	UFGA0001	UFGA	90-N	0	DR001	0	0	0	LOSA	180	UFGA7701

*INITIAL CONDITIONS

@C	PCR	ICDAT	ICRT	ICND	ICRN	ICRE
1	SB	81177	100	0	1.00	1.00

@C	ICBL	SH20	SNH4	SN03
1	5	0.086	0.6	1.5
1	15	0.086	0.6	1.5
1	30	0.086	0.6	1.5
1	45	0.086	0.6	1.5
1	60	0.086	0.6	1.5
1	90	0.076	0.6	0.6
1	120	0.076	0.6	0.5

1	150	0.130	0.6	0.5
1	180	0.258	0.6	0.5

*PLANTING DETAILS

@P	PDATE	EDATE	PPOP	PPOE	PLME	PLDS	PLRS	PLRD	PLDP	PLWT	PAGE	PENV	PLPH
1	81177		9.5	9.5	S	R	100	0	4.0	-99	-99	-99.0	-99.0

*IRRIGATION AND WATER MANAGEMENT

@I	IEFF	IDEP	ITHR	IEPT	IOFF	IAME	IAMT
1	1.00	30	50	100	IB001	IB001	15

@I	IDATE	IROP	IRVAL
1	81204	IR001	19
1	81211	IR001	20
1	81227	IR001	20
1	81239	IR001	20
1	81249	IR001	20

*FERTILIZERS (INORGANIC)

@F	FDATE	FMCD	FACD	FDEP	FAMN	FAMP	FAMK	FAMC	FAMO	FOCD
1	81177	FE005	AP001	10	50	0	0	0	0	0
2	81177	FE005	AP001	10	100	0	0	0	0	0

*RESIDUES AND OTHER ORGANIC MATERIALS

@R	RDATE	RCOD	RAMT	RESN	RESP	RESK	RINP	RDEP
1	81177	RE001	1000	0.80	0.00	0.00	100	15

*SIMULATION CONTROLS

@N	GENERAL	NYERS	NREPS	START	SDATE	RSEED	SNAME.....
1		1	1	S	81177	2150	MAIZE-IRRIG & NITROGEN

@N	OPTIONS	WATER	NITRO	SYMBI	PHOSP	POTAS	DISES
1		Y	Y	N	N	N	N

@N	METHODS	WTHR	INCON	LIGHT	EVAP0	INFIL	PHOTO
1		M	M	E	R	S	C

@N	MANAGEMENT	PLANT	IRRIG	FERTI	RESID	HARVS
1		R	R	R	R	M

@N	OUTPUTS	FNAME	OVVEW	SUMRY	FROPT	GROUT	CAOUT	WAOUT	NIOUT	MIOUT	DIOUT	LONG
1		N	Y	Y	3	Y	Y	Y	Y	N	N	N

@ AUTOMATIC MANAGEMENT

@N	PLANTING	PFRST	PLAST	PH20L	PH20U	PH20D	PSTMX	PSTMN
1		155	200	40	100	30	40	10

@N	IRRIGATION	IMDEP	ITHRL	ITHRU	IROFF	IMETH	IRAMT	IREFF
1		30	50	100	GS000	IR001	10	1.00

@N	NITROGEN	NMDEP	NMTHR	NAMNT	NCODE	NAOFF
1		30	50	25	FE001	GS000

@N	RESIDUES	RIPCEN	RTIME	RIDEP
1		100	1	20

@N	HARVEST	HFRST	HLAST	HPCNP	HPCNR
1		0	365	100	0

WEATHER DATA FILE

Daily weather data are required and must be available for the duration of the growing season, beginning with the day of planting and ending at crop maturity. Ideally, the weather file (FILEW) should contain data collected from before planting to after maturity. This would allow a simulation to be started before planting, thus providing an estimate of soil conditions at planting time. Additional weather data would also allow users to select alternate planting dates, simulate planting decisions based on weather and soil conditions, and simulate longer duration crop cultivars for model sensitivity analysis.

These files should be named according to the file naming convention described previously in the section entitled “File Naming Conventions.” The first lines in each weather data file, regardless of file length, contain some details of the site (name, country, annual average temperature and amplitude of its monthly averages, latitude and longitude, elevation). On all subsequent lines, there could be 8 variables, 7 of which are different weather aspects. It is not necessary to have data for all variables, but the minimum data required for DSSAT v3 crop models are solar radiation, minimum and maximum air temperature and rainfall. The standard format for variables should be followed. The structure of the file and an abbreviated example is shown in Table 9. The file as presented is similar to the standard weather data file used by IBSNAT models in DSSAT v2.1 (IBSNAT, 1989), but scope for more variables has been added. The DSSAT v2.1 files only included total solar radiation, maximum and minimum air temperature, and precipitation.

TABLE 9. WEATHER DATA FILE. (FILEW)
STRUCTURE

Variable	Variable Name ¹	Header ²	Format ³
Line 1			
*WEATHER :		0	C 10
Site + country name		1	C 60
Line 2			
Institute code	INSTE	IN	2 C 2
Site code	SITEE	SI	0 C 2
Latitude, degrees (decimals)	XLAT	LAT	1 R 8 3
Longitude, degrees (decimals)	XLONG	LONG	1 R 8 3
Elevation, m	ELEV	ELEV	1 R 5 0
Air temperature average, °C	TAV	TAV	1 R 5 1
Air temperature amplitude, monthly averages, °C	TAMP	AMP	1 R 5 1
Height of temperature measurements, m	REFHT	TMHT	1 R 5 1
Height of wind measurements, m	WNDHT	WMHT	1 R 5 1
All other lines			
Year + days from Jan. 1	YRDOYW	DATE	0 I 5
Solar radiation, MJ m ⁻² day ⁻¹	SRAD	SRAD	1 R 5 1
Air temperature maximum, °C	TMAX	TMAX	1 R 5 1
Air temperature minimum, °C	TMIN	TMIN	1 R 5 1
Precipitation, mm	RAIN	RAIN	1 R 5 1
Dewpoint temperature ⁵ , °C	TDEW	DEWP	1 R 5 1
Wind run ⁵ , km day ⁻¹	WINDSP	WIND	1 R 5 1
Photosynthetic active radiation (PAR) ⁵ , moles m ⁻² day ⁻¹	PAR	PAR	1 R 5 1

¹ Abbreviations used as variable names in the IBSNAT models.

² Abbreviations suggested for use in header lines (those designated with '@') within the file.

³ Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.

⁴ The blank space following a weather variable can be used to place a "flag," which would indicate an estimated value had replaced missing or suspect data. (e.g., UFGAE 29.6 32.6...), where 'E' is the "flag" indicating the data item following it (i.e., '29.6') is an error value. In this example, since no "flag" precedes the '32.6', this number is a reported value. (See Appendix D for a full listing of Weather Flags.)

⁵ Optional data, which are used by crop models for some options but are not necessary.

EXAMPLE WEATHER DATA FILE. (FILEW = "UFGA7801.WTH")

```
*WEATHER : GAINESVILLE,FLORIDA,U.S.A
@ INSI      LAT      LONG  ELEV  TAV    AMP REFHT WNDHT
  UFGA    29.630   -82.370   40   20.9    7.4   1.5   2.0
@DATE  SRAD  TMAX  TMIN  RAIN
78001    5.3   18.3   13.3    4.8
78002   11.1   18.3    8.3    0.0
78003   14.7   13.9    3.3    0.0
78004   14.4   19.4    0.0    0.0
78005   10.9   23.9    6.7    0.0
78006   10.8   25.6   11.1    0.0
78007    9.5   25.0    9.4    0.0
78008    3.1   23.9   15.6   10.4
78009   16.3   18.3    1.1   25.1
78010   15.7    8.9   -3.9    0.0
78011   15.4   11.7   -2.8    0.0
78012    7.2   19.4    1.7    0.0
78013   10.9   20.0   13.3   27.9
78014   11.4   14.4    3.3    0.0
78015   14.2    7.8   -3.3    0.0
78016   13.2   16.1   -3.9    0.0
78017   10.4   21.7    9.4    4.8
78018   15.0   21.7    6.7    0.0
78019    0.6   19.4    8.9   71.9
78020    4.3   16.7    7.2    6.9
78021   10.4   10.0    1.1    0.0
78022   13.4   16.7    1.1    0.0
78023    6.6   16.7    7.8    0.0
78024   10.7   23.3    5.6    0.0
78025    7.4   26.1   16.7    0.0
78026   17.1   25.6    6.1    5.6
78027    7.4   12.2    0.0    0.0
78028   15.9   11.1   -1.1    0.0
78029   17.4   10.6   -4.4    0.0
78030   16.2   12.2   -3.3    0.0
78031    3.8   12.2    4.4    0.0
```

SOIL DATA FILE

The soil file (FILES) contains data on the soil profile properties. These data are used in the soil water, nitrogen, phosphorus and root growth sections of the crop models. The file generally contains information that is available for the soil at a particular experimental site, and supplementary information extracted from a soil survey database for a soil of the same taxonomic classification as the soil at the experimental site. Occasionally, when a detailed soil analysis has been performed at the experimental site, the file will contain no information from a survey database.

In FILES, the first line of data contains the soil identifiers, information on soil texture and depth, a description that could equate to the soil classification according to a specified, locally used system (such as the Canadian soil classification system), and the country. The second line contains geographic data together with taxonomic information presented according to Soil Taxonomy (Soil Survey Staff, 1975). The third line contains information on soil properties that do not vary with depth, such as surface albedo, and on measurement techniques. The fourth line contains data on the first layer; the fifth line on the second layer, and so on for each succeeding layer in the soil profile. The second tier of information for the soil layers is optional and contains variables related to the soil phosphorus balance, and other nutrients. Soil organic carbon is included in this file because it is frequently used to compute other soil properties. The percentage of sand is assumed to be 100 minus the percentages of clay and silt, and thus is not included as an input. The number of layers, and the thickness of each layer should be the same as those in the soil analysis and initial conditions sections of the experiment file whenever possible. The file may contain properties for several soils of the same classification, providing each soil has its own code number. The data for each soil are simply appended to the file. The structure of the file and a truncated example are shown in Table 10.

The data in the soils file are arranged so that entries need be made only for the aspects simulated. For example, if only water aspects are to be simulated, only those variables described as physical characteristics need be supplied. If only water and nitrogen aspects are to be simulated, then the physical, N and pH variables need to be entered. If phosphorus is to be considered, then all these latter variables plus all P variables must be entered.

TABLE 10. SOIL DATA FILE. (FILES)

STRUCTURE

Variable	Variable Name ¹	Header ²	Format ³
Line 1			
*SOILS:			0 C 10
Institute + country name			1 C 70
Subsequent lines relate to sections, as follows:			
Line 1			
Identifier (Institute + Site + Year + Soil)	PEDON	ID_SOIL	1 C 10
Source	SLSOUR	SLSOURCE	2 C 11
Texture, code ⁴	SLTX	SLTX	1 C 5
Depth, cm	SLDP	SLDP	1 R 5 0
Description or local classification	SLDESC	SLDESCRIP	1 C 50
Line 2			
Site name	SSITE	SITE	1 C 11
Country name	SCOUNT	COUNTRY	1 C 11
Latitude	SLAT	LAT	1 R 8 3
Longitude	SLONG	LONG	1 R 8 3
Family, SCS system	TACON	SCSFAMILY	1 C 50
Line 3			
Color, moist, Munsell hue	SCOM	SCOM	1 C 5
Albedo, fraction	SALB	SALB	1 R 5 2
Evaporation limit, cm	U	SLU1	1 R 5 0
Drainage rate, fraction day ⁻¹	SWCON	SLDR	1 R 5 2
Runoff curve number (Soil Conservation Service)	CN2	SLR0	1 R 5 0
Mineralization factor, 0 to 1 scale	SLNF	SLNF	1 R 5 2
Photosynthesis factor, 0 to 1 scale	SLPF	SLPF	1 R 5 2
pH in buffer determination method, code ⁴	SMHB	SMHB	1 C 5
Phosphorus, extractable, determination code ⁴	SMPX	SMPX	1 C 5
Potassium determination method, code ⁴	SMKE	SMKE	1 C 5
Line 4 + (NL-1), where NL = number of layers.			
(L = Layer number)			
Depth, base of layer, cm	ZLYR(L)	SLB	1 R 5 0
Master horizon	MH(L)	SLMH	1 C 5
Lower limit, cm ³ cm ⁻³	LL(L)	SLLL	1 R 5 3
Upper limit, drained, cm ³ cm ⁻³	DUL(L)	SDUL	1 R 5 3

Upper limit, saturated, $\text{cm}^3 \text{ cm}^{-3}$	SAT(L)	SSAT	1 R 5 3
Root growth factor, 0.0 to 1.0	SHF(L)	SRGF	1 R 5 2
Sat. hydraulic conductivity, macropore, cm h^{-1}	SWCN(L)	SSKS	1 R 5 1
Bulk density, moist, g cm^{-3}	BD(L)	SBDM	1 R 5 2
Organic carbon, %	OC(L)	SLOC	1 R 5 2
Clay ($<0.002 \text{ mm}$), %	CLAY(L)	SLCL	1 R 5 1
Silt ($0.05 \text{ to } 0.002 \text{ mm}$), %	SILT(L)	SLSI	1 R 5 1
Coarse fraction ($>2 \text{ mm}$), %	STONES(L)	SLCF	1 R 5 1
Total nitrogen, %	TOTN(L)	SLNI	1 R 5 2
pH in water	PH(L)	SLHW	1 R 5 1
pH in buffer	PHKCL(L)	SLHB	1 R 5 1
Cation exchange capacity, cmol kg^{-1}	CEC(L)	SCEC	1 R 5 1

Line 4 + NL to (4 + NL + (NL - 1)), where NL = number of layers.

(L = Layer number)

Depth, base of layer, cm	ZZLYR(L)	SLB	1 R 5 0
Phosphorus, extractable, mg kg^{-1}	EXTP(L)	SLPX	1 R 5 1
Phosphorus, total, mg kg^{-1}	TOTP(L)	SLPT	1 R 5 1
Phosphorus, organic, mg kg^{-1}	ORGP(L)	SLPO	1 R 5 1
CaCO_3 content, g kg^{-1}	CACO(L)	SLCA	1 R 5 1
Aluminum	EXTAL(L)	SLAL	1 R 5 1
Iron	EXTFE(L)	SLFE	1 R 5 1
Manganese	EXTMN(L)	SLMN	1 R 5 1
Base saturation, cmol kg^{-1}	TOTBAS(L)	SLBS	1 R 5 1
Phosphorus isotherm A, mmol kg^{-1}	PTERMA(L)	SLPA	1 R 5 1
Phosphorus iostherm B, mmol kg^{-1}	PTERMB(L)	SLPB	1 R 5 1
Potassium, exchangeable, cmol kg^{-1}	EXK(L)	SLKE	1 R 5 1
Magnesium, cmol kg^{-1}	EXMG(L)	SLMG	1 R 5 1
Sodium, cmol kg^{-1}	EXNA(L)	SLNA	1 R 5 1
Sulfur	EXTS(L)	SLSU	1 R 5 1
Electric conductivity, seimen	SLEC(L)	SLEC	1 R 5 1

¹ Abbreviations used as variable names in the IBSNAT models.

² Abbreviations suggested for use in header lines (those designated with '@') within the file.

³ Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.

⁴ For a complete listing of these codes, see Appendix B.

EXAMPLE SOIL DATA FILE. (FILES = "SOIL.SOL")

*SOIL INPUT FILE

```
*IBMZ910014  SCS          FSA      180 Millhopper Fine Sand
@SITE          COUNTRY      LAT      LONG SCS FAMILY
Gainesville USA          29.63    -82.37 Loamy,silic,hyperth Arenic Paleudult ( 14)
@ SCOM  SALB  SLU1  SLDR  SLR0  SLNF  SLPF  SMHB  SMPX  SMKE
  99  0.18   2.0   0.65  60.0   1.00  0.80 SA001 SA001 SA001
@  SLB  SLMH  SLLL  SDUL  SSAT  SRGF  SSKS  SBDM  SLOC  SLCL  SLNI  SLCF  SLHW  SLHB  SCEC
   5  -99  0.026 0.096 0.230 1.000  -99  1.30  2.00  -99  -99  -99  -99  -99  -99
  15  -99  0.025 0.086 0.230 1.000  -99  1.30  1.00  -99  -99  -99  -99  -99  -99
  30  -99  0.025 0.086 0.230 0.800  -99  1.40  1.00  -99  -99  -99  -99  -99  -99
  60  -99  0.025 0.086 0.230 0.200  -99  1.40  0.50  -99  -99  -99  -99  -99  -99
  90  -99  0.028 0.090 0.230 0.100  -99  1.45  0.10  -99  -99  -99  -99  -99  -99
 120  -99  0.028 0.090 0.230 0.050  -99  1.45  0.10  -99  -99  -99  -99  -99  -99
 150  -99  0.029 0.130 0.230 0.002  -99  1.45  0.04  -99  -99  -99  -99  -99  -99
 180  -99  0.070 0.258 0.360 0.000  -99  1.20  0.24  -99  -99  -99  -99  -99  -99
```

GENOTYPE

Three files are suggested for dealing with the morphological and physiological characteristics of a particular genotype: one for the specific species (crop) characteristics (FILEG), one for the “ecotype” characteristics within a species (FILEE), and one for the specific cultivar characteristics within an ecotype grouping (FILEC).

These files would contain all genotype specific inputs required for simulation. Their content and organization, and indeed their usage, currently vary greatly among crop models and crops. No attempt has been made, therefore, to document contents. The use of at least one genotype file, specifically FILEC, is highly recommended. For such a file, a standard format is recommended with each line beginning with 6 spaces for a cultivar identification code (the first two items should be the code for the Institute that assigned the number), a blank, 16 spaces for the cultivar name, a blank, 6 spaces for a type identifier (e.g., an identifier for highland or lowland bean ecotypes), and then data in a (1X, F5.?) format (i.e., 1 blank, followed by 5 spaces for a real variable with the required number of decimals).

CHAPTER FOUR.

OUTPUTS

A number of output files for each simulation run, which may encompass several experiments, are described in Table 1. The first output file, OVERVIEW.OUT (Table 11), provides an overview of input conditions and crop performance, and a comparison with actual data if available. The first section in this file presents information that uniquely describes the simulated data set, as described below.

- Line 1: Run number and description; default to experiment code and name plus treatment number and name
- Line 2: Model name and version
- Line 3: Experiment name, Institute code, Site code, Experiment no., Crop (group) code
- Line 4: Treatment number and specifications
- Line 5: Crop, cultivar, ecotype
- Line 6: Simulation starting date
- Line 7: Planting date, population, and row spacing
- Line 8: Weather location, site and year
- Line 9: Soil number, texture and family
- Line 10: Soil initial conditions
- Line 11: Water balance
- Line 12: Irrigation
- Line 13: Nitrogen balance
- Line 14: Fertilizer N applications
- Line 15: Residue applications
- Line 16: Environmental options
- Line 17: Simulation options
- Line 18: Management options

The second section contains a summary of soil characteristics and cultivar coefficients. The next section deals with the crop and soil status at the main developmental stages, followed by a comparison of simulated and measured data for major variables. This in turn is followed by information on simulated stress factors and weather data summary during the different developmental phases (as

appropriate to the crop). An example of the file is shown in Table 11. The second output file, SUMMARY.OUT (Table 12), provides a summary of outputs for use in applications programs with one line of data for each crop season. The third to last files contain detailed simulation results, including simulated seasonal (at daily or less frequent intervals) growth and development (Table 13), carbon balance (Table 14), water balance (Table 15), nitrogen balance (Table 16), phosphorus balance and pest (Table 17) aspects. These files are included for detailed graphic and numerical comparisons of simulated results with data collected periodically during a growing season. They can be saved in files named according to the code of the first experiment in the simulation session, but with a final letter to indicate the aspect dealt with in the file.

All of the above output files are set up so that successive simulated results in one session are appended to the respective files. The output files are temporary information transfer files, created during simulation, and they are overwritten when a new simulation session is started. The output files can include additional information such as may relate to parameter changes for sensitivity analysis. However, the symbol “!” should be put in column 1 when such additional information is included in the output files. The “!” symbol designates a comment and graphics and other analysis programs must be designed to ignore these lines.

TABLE 11. EXAMPLE OF THE SIMULATION OVERVIEW FILE. (OUT0)

*SIMULATION OVERVIEW FILE

```
*RUN 1      : IRRIGATED, COBB
MODEL       : CRGR0940 - SOYBEAN
EXPERIMENT  : UFGA8101 SB    COBB, IRRIGATED, VEG. & REPROD. STRESS
TREATMENT 1 : IRRIGATED, COBB

CROP        : SOYBEAN          CULTIVAR : COBB                - MATURITY GROUP 8
STARTING DATE : JUN 26 1981
PLANTING DATE : JUN 26 1981    PLANTS/m2 : 35.9          ROW SPACING : 76.cm
WEATHER      : UFGA 1981
SOIL         : IBSB910015      TEXTURE : - Millhopper Fine Sand
SOIL INITIAL C : DEPTH:180cm EXTR. H2O:158.4mm N03: .0kg/ha NH4: .0kg/ha
WATER BALANCE : IRRIGATE ACCORDING TO FIELD SCHEDULE
IRRIGATION   : 315 mm IN 19 APPLICATIONS
NITROGEN BAL. : SOIL-N, N-UPTAKE & DYNAMIC N-FIXATION SIMULATION
N FERTILIZER  : 0 kg/ha IN 0 APPLICATIONS
RESIDUE/MANURE : 0 kg/ha IN 0 APPLICATIONS
ENVIRONM. OPT. : DAYL= .0 SRAD= .0 TMAX= .0 TMIN= .0
                RAIN= .0 CO2 = R 330.0 DEW = .0 WIND= .0
SIMULATION OPT : WATER :Y NITROGEN:Y N-FIX:Y PESTS :N PHOTO :C ET :R
MANAGEMENT OPT : PLANTING:R IRRIG :R FERT :R RESIDUE:R HARVEST:M WTH:M
```

*SUMMARY OF SOIL AND GENETIC INPUT PARAMETERS

SOIL DEPTH cm	LOWER LIMIT cm3/cm3	UPPER LIMIT cm3/cm3	SAT SW cm3/cm3	EXTR SW cm3/cm3	INIT SW cm3/cm3	ROOT DIST	BULK DENS g/cm3	pH	N03 ugN/g	NH4 ugN/g	ORG C %
0- 5	.023	.086	.230	.063	.086	1.00	1.36	5.30	.00	.00	.90
5- 15	.023	.086	.230	.063	.086	1.00	1.40	5.40	.00	.00	.69
15- 30	.023	.086	.230	.063	.086	.50	1.46	5.70	.00	.00	.28
30- 45	.023	.086	.230	.063	.086	.29	1.47	5.80	.00	.00	.20
45- 60	.023	.086	.230	.063	.086	.29	1.47	5.80	.00	.00	.20
60- 90	.021	.076	.230	.055	.076	.38	1.43	5.90	.00	.00	.09
90-120	.020	.076	.230	.056	.076	.13	1.48	5.90	.00	.00	.03
120-150	.027	.130	.230	.103	.130	.06	1.57	5.90	.00	.00	.03
150-180	.070	.258	.360	.188	.258	.03	1.79	5.90	.00	.00	.03
TOT-180	5.5	21.4	45.3	15.8	21.4	<--cm	- kg/ha-->		.0	.0	38949
SOIL ALBEDO	:	.18				EVAPORATION LIMIT	: 5.00		MIN. FACTOR	:	1.00
RUNOFF CURVE #	:	66.00				DRAINAGE RATE	: .50		FERT. FACTOR	:	.84

SOYBEAN CULTIVAR :IB0002-COBB ECOTYPE :SB0801-MATURITY GROUP 8
 CSDVAR :12.25 PPSEN : .33 EMG-FLW:21.00 FLW-FSD:16.00 FSD-PHM :37.00
 WTPSD : .180 SDPDVR : 2.05 SDFDUR :23.00 PODDUR :15.00 XFRUIT : 1.00

*SIMULATED CROP AND SOIL STATUS AT MAIN DEVELOPMENT STAGES

RUN NO. 1 IRRIGATED, COBB

	DATE	CROP AGE	GROWTH STAGE	BIOMASS kg/ha	LAI	LEAF NUM.	ET mm	RAIN mm	IRRIG mm	SWATER mm	CROP kg/ha	N %	STRESS H2O	N
26 JUN	0	START	SIM	0	.00	.0	4	18	0	172	0	.0	.00	.00
26 JUN	0	SOWING		0	.00	.0	4	18	0	172	0	.0	.00	.00
29 JUN	3	EMERGENCE		25	.04	.0	5	19	0	162	1	5.1	.00	.00
29 JUN	3	END JUVEN.		25	.04	.0	5	19	0	162	1	5.1	.00	.00
7 JUL	11	UNIFOLIATE		81	.13	1.3	13	19	8	158	3	3.4	.00	.00
11 JUL	15	FLOWER IND		143	.25	2.3	25	41	8	161	4	3.0	.07	.00
11 AUG	46	FIRST FLWR		2630	4.45	11.1	165	141	85	157	96	3.7	.02	.00
27 AUG	62	FIRST POD		4320	5.41	15.5	230	165	142	157	153	3.6	.00	.00
27 AUG	62	FIRST POD		4320	5.41	15.5	230	165	142	157	153	3.6	.00	.00
29 AUG	64	END MSNODE		4337	5.20	16.1	235	192	142	180	155	3.6	.00	.00
5 SEP	71	END LEAF		5163	5.06	16.1	265	219	142	147	175	3.4	.00	.00
7 SEP	73	FIRST SEED		5355	4.96	16.1	272	221	157	153	179	3.3	.00	.00
8 OCT	104	END POD		7978	3.30	16.1	397	248	272	142	269	3.4	.00	.00
18 OCT	114	PHYS. MAT		8658	3.03	16.1	429	250	287	124	302	3.5	.00	.04
30 OCT	126	HARV. MAT		7340	.20	16.1	456	268	315	134	264	3.6	.00	.16
30 OCT	126	HARVEST		7340	.20	16.1	456	268	315	134	264	3.6	.00	.16

*MAIN GROWTH AND DEVELOPMENT VARIABLES

@	VARIABLE	PREDICTED	MEASURED
	-----	-----	-----
	ANTHESIS DATE (DAP)	46	47
	FIRST PEG / POD (DAP)	62	66
	FIRST SEED (DAP)	73	66
	PHYSIOLOGICAL MATURITY (DAP)	114	118
	POD YIELD (kg/ha)	4545	4526.
	SEED YIELD (kg/ha)	3575	3502.
	SHELLING PERCENTAGE (%)	78.65	-99
	WEIGHT PER SEED (g)	.165	.1476
	SEED NUMBER (SEED/m2)	2166	2374.
	SEEDS/POD	2.05	1.88
	MAXIMUM LAI (m2/m2)	5.41	6.25
	BIOMASS (kg/ha) AT ANTHESIS	2630	-99
	BIOMASS N (kg N/ha) AT ANTHESIS	96	-99

BIOMASS (kg/ha) AT HARVEST MAT.	7340	6851.
STALK (kg/ha) AT HARVEST MAT.	2712	2137.
HARVEST INDEX (kg/kg)	.487	-99
FINAL LEAF NUMBER (MAIN STEM)	16.10	-99
SEED N (kg N/ha	228	-99
BIOMASS N (kg N/ha)	264	-99
STALK N (kg N/ha)	21	-99
SEED N (%)	6.37	-99

*ENVIRONMENTAL AND STRESS FACTORS

-----ENVIRONMENT-----					-----STRESS-----				
---DEVELOPMENT PHASE--		TIME-	-----WEATHER-----				---WATER--	---NITROGEN--	
		DURA	TEMP	TEMP	SOLAR	PHOTOP	PHOTO	GROWTH	PHOTO
		TION	MAX	MIN	RAD	[day]	SYNTH		SYNTH
		days	oC	oC	MJ/m2	hr			

Emergence -First Flower	43	34.07	22.26	20.01	13.60	.000	.019	.000	.000
First Flower-First Seed	27	32.41	21.98	16.30	12.80	.000	.000	.000	.000
First Seed - Phys. Mat.	41	30.87	17.54	16.38	11.78	.000	.000	.049	.009
Emergence - Phys. Mat.	111	32.48	20.45	17.77	12.73	.000	.007	.018	.003

(0.0 = Minimum Stress
1.0 = Maximum Stress)

SOYBEAN YIELD : 3575 kg/ha [DRY WEIGHT]

TABLE 12. DETAILED SIMULATION SUMMARY OUTPUT FILE. (OUTS)

STRUCTURE

Variable	Variable Name ¹	Header ²	Format ³
Line 1			
*SUMMARY :			0 C 10
Institute code	INSTE		1 C 2
Site code	SITEE		0 C 2
Experiment code	EXPTNO		0 C 4
Crop group code	CROP		1 C 2
Experiment name	ENAME		1 C 60
Line 2 to number runs made. Details of each simulation run, as follows:			
Run number	RUNO	RP	0 I 2
Treatment number	TRTNO	TN	1 I 2
Rotation component	ROTN0	R	1 I 1
Rotation option	ROTOPT	O	0 I 1
Crop component	CRPNO	C	0 I 1
Crop code	CROP	CR	1 C 2
Title	TITLET	TNAM	1 C 19
Field identifier	FLDNAM	FNAM	1 C 8
Simulation start date, year + day of year	YRSIM	SDAT	1 I 5
Planting date, year + day of year	YRPLT	PDAT	1 I 5
Anthesis date, start, year + day of year	YRNR1	ADAT	1 I 5
Maturity (physiological) date, year+day of year	YRNR7	MDAT	1 I 5
Harvest date, year + day of year	YRDOY	HDAT	1 I 5
Planting material dry weight, kg ha ⁻¹	SDRATE	DWAP	1 I 5
Canopy dry weight at maturity, kg ha ⁻¹	TOPWT	CWAM	1 I 5
Yield at maturity, kg ha ⁻¹	SDWT	HWAM	1 I 5
Yield at harvest, kg ha ⁻¹	SDWTAM	HWAH	1 I 5
Harvested byproduct dry weight, kg ha ⁻¹	BWAH	BWAH	1 I 5
Harvest product individual dry wt., mg or g	HWUM	HWUM	1 I 5
Harvest product number per m ² at maturity	SEEDNO	H#AM	1 I 5
Harvest product number per unit at maturity	PSPP	H#UM	1 R 5 2
Irrigation applications, number	NAP	IR#M	1 I 5
Irrigation applied, cumulative, mm	TOTIR	IRCM	1 I 5
Precipitation cumulative, mm	CRAIN	PRCM	1 I 5
Evapotranspiration in season, cumulative, mm	CET	ETCM	1 I 5
Runoff, cumulative, mm	TRUNOF	ROCM	1 I 5
Cumulative drainage from profile, mm	TDRAIN	DRCM	1 I 5
Water remaining in soil, available, mm	PESW	SWXM	1 I 5
Nitrogen applications, number	NAPNIT	NI#M	1 I 5
Nitrogen applied, cumulative, kg ha ⁻¹	AMTNIT	NICM	1 I 5

Nitrogen fixed, cumulative, kg ha ⁻¹	WTNFX	NFXM	1 I 5
Total N uptake during season, kg/ha	WTNUP	NUCM	1 I 5
Nitrogen leached, cumulative, kg ha ⁻¹	TLCH	NLCM	1 I 5
Inorganic N in soil at maturity, kg/ha	TSIN	NIAM	1 I 5
Tops N at maturity, kg ha ⁻¹	WTNCAN	CNAM	1 I 5
Nitrogen in harvest product (seed), kg ha ⁻¹	WTNSD	GNAM	1 I 5
Residue, etc. applied, cumulative, kg ha ⁻¹	CRESAP	RECM	1 I 5
Soil organic N at end of season, kg ha ⁻¹	TSOIN	ONAM	1 I 5
Soil C at end of season, t ha ⁻¹	TSOC	OCAM	1 I 5
Number of phosphorus applications	NNAPHO	PO#M	1 I 5
Total P applied during season, kg/ha	TOTPH	POCM	1 I 5
Cumulative plant P uptake, kg/ha	TOTPUP	CPAM	1 I 5
Soil P at end of season, kg/ha	TPLEFT	SPAM	1 I 5

¹ Abbreviations used as variable names in the IBSNAT models.

² Abbreviations suggested for use in header lines (those designated with '@') within the file.

³ Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.

EXAMPLE SUMMARY OUTPUT FILE

*SUMMARY : UFGA8101 SB COBB, IRRIGATED, VEG. & REPROD. STRESS

!IDENTIFIERS..... DATES.....
 @RP TN ROC CR TNAM FNAM SDAT PDAT ADAT MDAT HDAT
 1 1 110 SB IRRIGATED, COBB UFGA0001 81177 81177 81223 81291 81303
 2 2 110 SB IRRIGATED, WITH VEG UFGA0001 81177 81177 81224 81293 81305
 3 3 110 SB IRRIGATED, WITH REP UFGA0001 81177 81177 81223 81291 81303
 1 1 110 SB IRRIGATED UFGA0001 78166 78166 78211 78282 78294
 2 2 110 SB NON - IRRIGATED UFGA0001 78166 78166 78211 78278 78290

DRY WEIGHTS.....
 DWAP CWAM HWAM HWAH BWAH HWUM H#AM H#UM
 81 7340 3575 3575 3765 165 2166 2.05
 81 6178 3174 3174 3004 157 2021 2.05
 81 7038 3389 3389 3649 159 2126 2.05
 75 6116 2962 2962 3153 134 2208 2.05
 75 3056 1139 1139 1917 145 784 2.05

WATER.....
 IR#M IRCM PRCM ETCM ROCM DRCM SWXM
 19 315 268 456 0 72 134
 13 206 269 424 0 36 121
 15 264 268 448 0 72 104
 19 190 534 440 31 290 74
 0 0 534 319 31 284 59

NITROGEN.....
 NI#M NICM NFXM NUCM NLCM NIAM CNAM GNAM
 0 0 352 2 0 32 264 228
 0 0 322 1 0 29 234 202
 0 0 342 1 0 31 252 216
 0 0 314 4 20 39 222 189
 0 0 204 2 20 37 96 73

ORGANIC MATTER... PHOSPHORUS.....						
RECM	ONAM	OCAM	PO#M	POCM	CPAM	SPAM
0	3870	39	0	0	0	0
0	3873	39	0	0	0	0
0	3873	39	0	0	0	0
1000	3838	39	0	0	0	0
1000	3842	39	0	0	0	0

TABLE 13. DETAILED SIMULATION GROWTH OUTPUT FILE. (OUTG)

STRUCTURE

Variable	Variable Name ¹	Header ²	Format ³
Line 1			
Run number ⁴	NREP	5	I 3
Run identifier	TITLER	1 0	C 25
Line 2			
Model name	MODEL	18	C 8
Crop name	CROPD	3	C 10
Line 3			
Experiment identifier, made up of:			
Institute code	INSTE	18	C 2
Site code	SITEE	0	C 2
Experiment number/abbreviation	EXPTNO	0	C 4
Crop group code	CROP	1	C 2
Experiment name (Treatment set and experimental condition names, separated by a semi-colon)	ENAME	18	C 60
Line 4			
Treatment number	TRTNO	11	I 2
Treatment name	TITLET	5	C 25
Line 5⁵			
Variable abbreviations		1	C 77+
Line 6 on			
Date (Year + days from Jan. 1)	YRDOY	DATE	1 I 5
Crop age (days from planting)	DAP	CDAY	1 I 5
Leaf number	VSTAGE	L#SD	1 R 5 1
Growth stage	RSTAGE	GSTD	1 I 5
Leaf area index	XLAI	LAID	1 R 5 2
Leaf dry weight, kg ha ⁻¹	WTLF	LWAD	1 I 5
Stem dry weight, kg ha ⁻¹	STMWT	SWAD	1 I 5
Grain dry weight, kg ha ⁻¹	SDWT	GWAD	1 I 5
Root dry weight in layer L, kg ha ⁻¹	RTWT	RWAD	1 I 5
Crop dry weight, kg ha ⁻¹	TOPWT	CWAD	1 I 5
Grain number, #/m ²	SEEDNO	G#AD	1 I 5
Grain dry weight, mg/grain	SDSIZE	GWGD	1 R 5 1
Harvest index	HI	HIAD	1 R 5 3

-
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 - 2 Abbreviations suggested for use in header lines (those designated with '@') within the file. They correspond to the variable names used in the associated database.*
 - 3 Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.*
 - 4 Each new run should be demarcated with '*RUN' at the beginning of this line in each file.*
 - 5 Additional information can be placed between lines 4 and 5, as required by a user, as illustrated in the example, and as documented for the Overview file in the text.*

EXAMPLE GROWTH OUTPUT FILE

*GROWTH ASPECTS OUTPUT FILE

```
*RUN      1      : IRRIGATED, COBB
MODEL      : CRGR0940 - SOYBEAN
EXPERIMENT  : UFGA8101 SB      COBB, IRRIGATED, VEG. & REPROD. STRESS
TREATMENT  1      : IRRIGATED, COBB

CROP       : SOYBEAN          CULTIVAR : COBB                - MATURITY GROUP 8
STARTING DATE : JUN 26 1981
PLANTING DATE : JUN 26 1981    PLANTS/m2 : 35.9      ROW SPACING : 76.cm
WEATHER      : UFGA 1981
SOIL         : IBSB910015     TEXTURE :      - Millhopper Fine Sand
SOIL INITIAL C : DEPTH:180cm EXTR. H2O:158.4mm NO3: .0kg/ha NH4: .0kg/ha
WATER BALANCE : IRRIGATE ACCORDING TO FIELD SCHEDULE
IRRIGATION   :      315 mm IN    19 APPLICATIONS
NITROGEN BAL. : SOIL-N, N-UP TAKE & DYNAMIC N-FIXATION SIMULATION
N FERTILIZER :      0 kg/ha IN    0 APPLICATIONS
RESIDUE/MANURE :      0 kg/ha IN    0 APPLICATIONS
ENVIRONM. OPT. : DAYL=      .0 SRAD=      .0 TMAX=      .0 TMIN=      .0
                RAIN=      .0 CO2 = R 330.0 DEW =      .0 WIND=      .0
SIMULATION OPT : WATER :Y NITROGEN:Y N-FIX:Y PESTS :N PHOTO :C ET :R
MANAGEMENT OPT : PLANTING:R IRRIG :R FERT :R RESIDUE:R HARVEST:M WTH:M
```

@DATE	CDAY	L#SD	GSTD	LAID	LWAD	SWAD	GWAD	RWAD	CWAD	G#AD	GWGD	HIAD
81177	0	.0	0	.00	0	0	0	0	0	0	.0	.000
81183	6	.4	0	.07	35	6	0	23	41	0	.0	.000
81189	12	1.6	0	.16	77	15	0	44	92	0	.0	.000
81195	18	3.1	0	.40	173	46	0	98	219	0	.0	.000
81201	24	4.9	0	.95	313	134	0	192	447	0	.0	.000
81207	30	6.5	0	1.75	533	324	0	381	858	0	.0	.000
81213	36	8.2	0	2.82	801	613	0	567	1414	0	.0	.000
81219	42	9.9	0	3.84	1080	1047	0	753	2127	0	.0	.000
81225	48	11.7	1	4.73	1325	1560	0	905	2885	0	.0	.000
81231	54	13.4	1	5.32	1540	2078	0	1051	3619	0	.0	.000
81237	60	15.0	1	5.39	1618	2473	0	1161	4091	0	.0	.000
81243	66	16.1	3	5.15	1658	2859	0	1264	4533	0	.0	.000
81249	72	16.1	3	4.99	1760	3303	0	1366	5232	0	.0	.000
81255	78	16.1	5	4.71	1799	3625	34	1437	5897	403	8.4	.006
81261	84	16.1	5	4.31	1699	3648	298	1429	6425	950	31.4	.046
81267	90	16.1	5	3.97	1578	3523	777	1402	6901	1453	53.5	.113
81273	96	16.1	5	3.63	1425	3315	1544	1333	7364	2106	73.3	.210
81279	102	16.1	5	3.37	1318	3182	2331	1280	7868	2166	107.6	.296

TABLE 14. DETAILED SIMULATION CARBON BALANCE OUTPUT FILE. (OUTC)

STRUCTURE

Variable	Variable Name ¹	Header ²	Format ³
Line 1			
Run number ⁴	NREP		5 I 3
Run identifier	TITLER		10 C 25
Line 2			
Model name	MODEL		18 C 8
Crop name	CROPD		3 C 10
Line 3			
Experiment identifier, made up of:			
Institute code	INSTE		18 C 2
Site code	SITEE		0 C 2
Experiment number/abbreviation	EXPTNO		0 C 4
Crop group code	CROP		1 C 2
Experiment name (Treatment set and experimental condition names, separated by a semi-colon)	ENAME		18 C 60
Line 4			
Treatment number	TRTNO		11 I 2
Treatment name	TITLET		5 C 25
Line 5⁵			
Variable abbreviations			1 C 77+
Line 6 on			
Date (Year + days from Jan. 1)	YRDOY	DATE	1 I 5
Days from planting	DAP	CDAY	1 I 5
Soil organic carbon, kg ha ⁻¹	TSOC	S OCD	1 I 5
Total plant weight, kg ha ⁻¹	TOTWT	TWAD	1 I 5
Canopy interception of PAR, %	PCINP	LI%D	1 R 5 2
Canopy gross photosynthesis, g CH ₂ O/m ² /d	PG	PHAD	1 R 5 2
Carbon mobilized for growth, g CH ₂ O/m ² /d	CMINEA	CMAD	1 R 5 2
Canopy growth rate, g tissue/m ² /d	GROWTH	CGRD	1 R 5 2
Canopy growth resp, g CH ₂ O/m ² /d	GRWRES	GRAD	1 R 5 2
Canopy maint resp, g CH ₂ O/m ² /d	MAINR	MRAD	1 R 5 2
C stored in a day, g CH ₂ O/m ² /d	CAD	CHAD	1 R 5 2
Percent C in leaf, %	RHOL	CL%D	1 R 5 2
Percent C in stem, %	RHOS	CS%D	1 R 5 2

-
- 1 Abbreviations used as variable names in the IBSNAT models.*
 - 2 Abbreviations suggested for use in header lines (those designated with '@') within the file. They correspond to the variable names used in the associated database.*
 - 3 Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.*
 - 4 Each new run should be demarcated with '*RUN' at the beginning of this line in each file.*
 - 5 Additional information can be placed between lines 4 and 5, as required by a user, as illustrated in the example, and as documented for the Overview file in the text.*

EXAMPLE CARBON OUTPUT FILE

*CARBON BALANCE OUTPUT FILE

```
*RUN 1      : IRRIGATED, COBB
MODEL      : CRGR0930 - SOYBEAN
EXPERIMENT : UFGA8101 SB COBB, IRRIGATED, VEG. & REPROD. STRESS
TREATMENT 1 : IRRIGATED, COBB

CROP      : SOYBEAN      CULTIVAR : COBB      - MATURITY GROUP 8
STARTING DATE : JUN 26 1981
PLANTING DATE : JUN 26 1981  PLANTS/m2 : 35.9      ROW SPACING : 76.cm
WEATHER     : FGA 1981
SOIL        : IBSB910015  TEXTURE :      - Millhopper Fine Sand
SOIL INITIAL C : DEPTH:180cm EXTR. H2O:158.4mm N03: .0kg/ha NH4: .0kg/ha
WATER BALANCE : IRRIGATE ACCORDING TO FIELD SCHEDULE
IRRIGATION   :      315 mm IN 19 APPLICATIONS
NITROGEN BAL. : SOIL-N, N-UPTAKE & DYNAMIC N-FIXATION SIMULATION
N FERTILIZER  :      0 kg/ha IN 0 APPLICATIONS
RESIDUE/MANURE :      0 kg/ha IN 0 APPLICATIONS
ENVIRONM. OPT. : DAYL=      .0 SRAD=      .0 TMAX=      .0 TMIN=      .0
                RAIN=      .0 CO2 = R 330.0 DEW =      .0 WIND=      .0
SIMULATION OPT : WATER :Y NITROGEN:Y N-FIX:Y PESTS :N PHOTO :C ET :R
MANAGEMENT OPT : PLANTING:R IRRIG :R FERT :R RESIDUE:R HARVEST:M WTH:M
```

@DATE	CDAY	SOC	TWAD	LI%D	PHAD	CMAD	CGRD	GRAD	MRAD	CHAD	CL%D	CS%D
81177	0	39	0	.00	.00	.00	.00	.00	.00	.00	.00	.00
81183	6	39	64	.00	1.25	.00	.57	.34	.13	.21	20.39	21.35
81189	12	39	136	.00	2.81	.00	1.34	.79	.32	.35	29.76	27.58
81195	18	39	317	.00	6.96	.00	3.29	1.96	.80	.91	34.23	26.99
81201	24	39	638	.00	12.21	.28	7.40	3.75	1.34	.00	21.66	15.14
81207	30	39	1238	.00	21.69	.32	12.36	6.77	2.88	.00	12.12	9.59
81213	36	39	1981	.00	24.45	.37	14.46	6.91	3.44	.00	7.96	7.74
81219	42	39	2880	.00	29.19	.45	17.39	7.99	4.26	.00	5.88	6.86
81225	48	39	3789	.00	28.61	.55	16.32	7.60	4.77	.47	4.84	6.75
81231	54	39	4670	.00	28.54	.76	15.15	7.17	5.58	1.40	4.78	8.30
81237	60	39	5252	.00	31.56	1.00	16.14	8.17	5.44	2.81	5.16	10.40
81243	66	39	5797	.00	28.12	1.38	13.45	6.64	5.90	3.52	5.87	12.99
81249	72	39	6598	.00	24.16	1.99	11.82	4.98	6.27	3.08	6.79	16.00
81255	78	39	7334	.00	32.67	2.70	17.69	6.55	7.48	3.66	7.26	17.61
81261	84	39	7854	.00	31.39	3.11	19.23	8.03	5.14	2.10	7.11	17.31
81267	90	39	8304	.00	28.86	2.99	16.24	8.33	7.29	.00	6.10	14.90
81273	96	39	8697	.00	29.56	2.18	14.43	9.89	7.26	.15	5.02	12.28
81279	102	39	9148	.00	27.81	1.84	13.59	10.00	5.58	.49	4.12	10.21
81285	108	39	9393	.00	23.47	1.34	11.40	8.67	4.41	.34	3.04	7.65
81291	114	39	9860	.00	20.92	.00	2.93	2.05	5.48	10.46	3.56	9.62
81297	120	39	8922	.00	5.92	1.97	2.33	1.05	3.88	.63	1.12	18.71

TABLE 15. DETAILED SIMULATION WATER BALANCE OUTPUTFILE. (OUTW)

STRUCTURE

Variable	Variable Name ¹	Header ²	Format ³
Line 1			
Run number ⁴	NREP	5	I 3
Run identifier	TITLER	10	C 25
Line 2			
Model name	MODEL	18	C 8
Crop name	CROPD	3	C 10
Line 3			
Experiment identifier, made up of:			
Institute code	INSTE	18	C 2
Site code	SITEE	0	C 2
Experiment number/abbreviation	EXPTNO	0	C 4
Crop group code	CROP	1	C 2
Experiment name (Treatment set and experimental condition names, separated by a semi-colon)	ENAME	18	C 60
Line 4			
Treatment number	TRTNO	11	I 2
Treatment name	TITLET	5	C 25
Line 5⁵			
Variable abbreviations		1	C 77+
Line 6 on			
Date (Year + days from Jan. 1)	YRDOY	DATE	1 I 5
Days from planting	DAP	CDAY	1 I 5
Plant Transpiration, mm d ⁻¹	AVEP	EPAA	1 R 5 2
Evapotranspiration, mm day ⁻¹	AVET	ETAA	1 R 5 2
Potential evaporation, mm day ⁻¹	AVEO	EOAA	1 R 5 2
Potentially extractable water, cm	PESW	SWXD	1 R 5 1
Cumulative runoff	TRUNOF	ROFC	1 R 5 1
Cumulative drainage	TDRAIN	DRNC	1 I 5
Cumulative precipitation, mm	CRAIN	PREC	1 I 5
Cummulative irrigation, mm	TOTIR	IRRC	1 I 5
Average solar radiation, MJ m ⁻²	AVSRAD	SRAA	1 R 5 1
Average maximum temperature, °C	AVTMX	TMXA	1 R 5 1
Average minimum temperature, °C	AVTMN	TMNA	1 R 5 1

-
- 1 Abbreviations used as variable names in the IBSNAT models.*
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 - 3 Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.*
 - 4 Each new run should be demarcated with '*RUN' at the beginning of this line in each file.*
 - 5 Additional information can be placed between lines 4 and 5, as required by a user, as illustrated in the example, and as documented for the Overview file in the text.*

EXAMPLE WATER OUTPUT FILE

*WATER BALANCE OUTPUT FILE

```
*RUN 1      : IRRIGATED, COBB
MODEL       : CRGR0940 - SOYBEAN
EXPERIMENT  : UFGA8101 SB      COBB, IRRIGATED, VEG. & REPROD. STRESS
TREATMENT 1 : IRRIGATED, COBB

CROP        : SOYBEAN          CULTIVAR : COBB          - MATURITY GROUP 8
STARTING DATE : JUN 26 1981
PLANTING DATE : JUN 26 1981    PLANTS/m2 : 35.9        ROW SPACING : 76.cm
WEATHER      : UFGA 1981
SOIL         : IBSB910015     TEXTURE : - Millhopper Fine Sand
SOIL INITIAL C : DEPTH:180cm EXTR. H2O:158.4mm N03: .0kg/ha NH4: .0kg/ha
WATER BALANCE : IRRIGATE ACCORDING TO FIELD SCHEDULE
IRRIGATION   : 315 mm IN 19 APPLICATIONS
NITROGEN BAL. : SOIL-N, N-UP TAKE & DYNAMIC N-FIXATION SIMULATION
N FERTILIZER  : 0 kg/ha IN 0 APPLICATIONS
RESIDUE/MANURE : 0 kg/ha IN 0 APPLICATIONS
ENVIRONM. OPT. : DAYL= .0 SRAD= .0 TMAX= .0 TMIN= .0
                RAIN= .0 CO2 = R 330.0 DEW = .0 WIND= .0
SIMULATION OPT : WATER :Y NITROGEN:Y N-FIX:Y PESTS :N PHOTO :C ET :R
MANAGEMENT OPT : PLANTING:R IRRIG :R FERT :R RESIDUE:R HARVEST:M WTH:M
```

@DATE	CDAY	EPAA	ETAA	EOAA	SWXD	ROFC	DRNC	PREC	IRRC	SRAA	TMXA	TMNA
81177	0	.00	3.92	7.37	172.3	.0	.0	18	0	25.2	36.1	21.7
81183	6	.27	1.44	5.61	161.1	.0	12.5	19	8	22.2	32.8	19.2
81189	12	.53	2.05	5.35	166.7	.0	13.2	33	8	19.6	34.8	21.7
81195	18	1.47	3.88	5.83	169.7	.0	20.5	63	8	21.5	34.8	22.2
81201	24	1.97	2.62	3.73	156.2	.0	29.6	73	8	14.5	33.7	21.9
81207	30	5.20	5.55	6.62	143.9	.0	29.6	74	27	23.6	35.9	22.2
81213	36	2.60	3.93	3.93	161.6	.0	29.6	94	66	15.6	33.9	21.9
81219	42	4.05	5.20	5.20	163.5	.0	40.1	137	66	21.0	33.3	22.0
81225	48	4.45	5.26	5.26	151.2	.0	41.6	145	85	21.1	33.3	22.2
81231	54	3.93	4.25	4.25	139.8	.0	41.6	146	104	17.1	33.3	23.1
81237	60	4.00	4.44	4.44	151.6	.0	42.1	165	123	18.2	32.6	21.9
81243	66	3.18	3.59	3.59	197.7	.1	44.2	219	142	14.8	31.7	21.9
81249	72	3.44	3.76	3.76	156.2	.1	71.5	220	157	15.4	32.6	21.9
81255	78	4.00	4.56	4.56	148.9	.1	71.5	230	170	18.6	33.1	21.7
81261	84	2.52	2.99	2.99	152.2	.1	71.5	247	183	12.9	30.0	20.2
81267	90	3.69	4.25	4.25	143.1	.1	71.5	247	202	17.8	32.0	19.4
81273	96	3.78	4.51	4.51	139.5	.1	71.5	247	230	18.9	32.2	18.3
81279	102	3.45	3.76	3.76	129.6	.1	71.5	247	249	16.3	30.9	15.9
81285	108	2.46	2.78	2.78	133.5	.1	71.5	250	272	12.0	29.8	18.9
81291	114	3.22	3.76	3.76	123.6	.1	71.5	250	287	16.9	30.7	11.9
81297	120	1.63	2.77	2.89	129.2	.1	71.5	254	315	12.3	30.6	17.1

TABLE 16. DETAILED SIMULATION NITROGEN OUTPUT FILE. (OUTN)

STRUCTURE

Variable	Variable Name ¹	Header ²	Format ³
Line 1			
Run number ⁴	NREP		5 I 3
Run identifier	TITLER		10 C 25
Line 2			
Model name	MODEL		18 C 8
Crop name	CROPD		3 C 10
Line 3			
Experiment identifier, made up of:			
Institute code	INSTE		18 C 2
Site code	SITEE		0 C 2
Experiment number/abbreviation	EXPTNO		0 C 4
Crop group code	CROP		1 C 2
Experiment name (Treatment set and experimental condition names, separated by a semi-colon)	ENAME		18 C 60
Line 4			
Treatment number	TRTNO		11 I 2
Treatment name	TITLET		5 C 25
Line 5⁵			
Variable abbreviations			1 C 77+
Line 6 on			
Date (Year + days from Jan. 1)	YRDOY	DATE	1 I 5
Days from planting	DAP	CDAY	1 I 5
Crop nitrogen	WTNCAN	CNAD	1 R 5 1
Grain nitrogen, kg ha ⁻¹	WTNSD	GNAD	1 R 5 1
Veg. (stem + leaf) nitrogen, kg ha ⁻¹	WTNVEG	VNAD	1 R 5 1
Percent nitrogen in grain, %	PCNGRN	HN%D	1 R 5 2
Percent veg(stem+leaf) nitrogen, %	PCNVEG	VN%D	1 R 5 2
Cumulative inorganic N applied, kg ha ⁻¹	TANFGR	NAPC	1 R 5 I
Cumulative N fixation, kg ha ⁻¹	WTNFX	NFXC	1 R 5 1
Cumulative N uptake, kg ha ⁻¹	WTNUP	NUPC	1 R 5 1
Cumulative N leached, kg ha ⁻¹	TLCH	NLCC	1 R 5 1
Inorganic N in soil, kg ha ⁻¹	TSIN	NIAD	1 R 5 1
Organic N in soil, kg ha ⁻¹	TSOIN	NOAD	1 I 5

-
- 1 Abbreviations used as variable names in the IBSNAT models.*
 - 2 Abbreviations suggested for use in header lines (those designated with '@') within the file. They correspond to the variable names used in the associated database.*
 - 3 Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.*
 - 4 Each new run should be demarcated with '*RUN' at the beginning of this line in each file.*
 - 5 Additional information can be placed between lines 4 and 5, as required by a user, as illustrated in the example, and as documented for the Overview file in the text.*

EXAMPLE NITROGEN OUTPUT FILE

*NITROGEN BALANCE OUTPUT FILE

```
*RUN 1      : IRRIGATED, COBB
MODEL       : CRGR0940 - SOYBEAN
EXPERIMENT  : UFGA8101 SB COBB, IRRIGATED, VEG. & REPROD. STRESS
TREATMENT 1 : IRRIGATED, COBB

CROP        : SOYBEAN          CULTIVAR : COBB          - MATURITY GROUP 8
STARTING DATE : JUN 26 1981
PLANTING DATE : JUN 26 1981   PLANTS/m2 : 35.9        ROW SPACING : 76.cm
WEATHER      : UFGA 1981
SOIL         : IBSB910015     TEXTURE : - Millhopper Fine Sand
SOIL INITIAL C : DEPTH:180cm EXTR. H2O:158.4mm NO3: .0kg/ha NH4: .0kg/ha
WATER BALANCE : IRRIGATE ACCORDING TO FIELD SCHEDULE
IRRIGATION   : 315 mm IN 19 APPLICATIONS
NITROGEN BAL. : SOIL-N, N-UP TAKE & DYNAMIC N-FIXATION SIMULATION
N FERTILIZER  : 0 kg/ha IN 0 APPLICATIONS
RESIDUE/MANURE : 0 kg/ha IN 0 APPLICATIONS
ENVIRONM. OPT. : DAYL= .0 SRAD= .0 TMAX= .0 TMIN= .0
                RAIN= .0 CO2 = R 330.0 DEW = .0 WIND= .0
SIMULATION OPT : WATER :Y NITROGEN:Y N-FIX:Y PESTS :N PHOTO :C ET :R
MANAGEMENT OPT : PLANTING:R IRRIG :R FERT :R RESIDUE:R HARVEST:M WTH:M
```

@DATE	CDAY	CNAD	GNAD	VNAD	GN%D	VN%D	NAPC	NFXC	NUPC	NLCC	NIAD	NOAD
81177	0	.0	.0	.0	.00	.00	0	.0	.0	.0	.2	3895
81183	6	1.6	.0	1.6	.00	4.03	0	.6	.0	-.7	2.3	3893
81189	12	3.0	.0	3.0	.00	3.28	0	2.5	.0	-.7	3.6	3892
81195	18	6.3	.0	6.3	.00	2.89	0	7.2	.0	-1.2	5.4	3891
81201	24	14.3	.0	14.3	.00	3.21	0	17.9	.0	-1.8	7.3	3889
81207	30	30.4	.0	30.4	.00	3.54	0	38.9	.0	-1.8	8.4	3888
81213	36	52.5	.0	52.5	.00	3.72	0	64.7	.0	-1.8	9.6	3887
81219	42	78.8	.0	78.8	.00	3.70	0	94.8	.0	-2.5	11.6	3886
81225	48	105.3	.0	105.3	.00	3.65	0	124.4	.0	-2.6	13.0	3885
81231	54	130.2	.0	130.2	.00	3.60	0	152.9	.0	-2.6	14.2	3883
81237	60	146.3	.0	146.3	.00	3.58	0	174.1	.0	-2.7	15.5	3882
81243	66	160.2	.0	159.7	.00	3.53	0	193.4	.0	-2.8	16.8	3881
81249	72	176.7	.0	171.5	.00	3.39	0	213.6	.0	-4.7	19.9	3880
81255	78	186.2	2.1	170.9	6.37	3.15	0	227.5	.0	-4.7	21.1	3879
81261	84	193.2	19.0	152.1	6.37	2.84	0	237.6	.0	-4.7	22.3	3877
81267	90	210.3	49.5	133.5	6.37	2.62	0	257.4	.0	-4.7	23.3	3876
81273	96	233.4	98.4	109.4	6.37	2.31	0	282.1	.0	-4.7	24.4	3875
81279	102	262.4	148.5	92.4	6.37	2.05	0	312.1	.0	-4.7	25.5	3874
81285	108	281.1	184.6	78.2	6.37	1.83	0	330.7	.5	-4.7	31.0	3873
81291	114	301.8	213.7	71.7	6.37	1.66	0	352.2	.6	-4.7	31.8	3872
81297	120	270.5	222.2	33.7	6.37	1.02	0	352.2	1.3	-4.7	32.0	3871

TABLE 17. DETAILED SIMULATION PEST OUTPUT FILE. (OUTD)**STRUCTURE**

Variable	Variable Name ¹	Header ²	Format ³
Line 1			
Run number ⁴	NREP		5 I 3
Run identifier	TITLER		10 C 25
Line 2			
Model name	MODEL		18 C 8
Crop name	CROPD		3 C 10
Line 3			
Experiment identifier, made up of:			
Institute code	INSTE		18 C 2
Site code	SITEE		0 C 2
Experiment number/abbreviation	EXPTNO		0 C 4
Crop group code	CROP		1 C 2
Experiment name (Treatment set and experimental condition names, separated by a semi-colon)	ENAME		18 C 60
Line 4			
Treatment number	TRTNO		11 I 2
Treatment name	TITLET		5 C 25
Line 5⁵			
Variable abbreviations			1 C 77+
Line 6 on			
Date (Year and days from Jan. 1)	YRDOY	DATE	1 I 5
Crop age (days from planting)	DAP	CDAY	1 I 5
Daily diseased leaf area increase, cm ² /m ² /d	DISLA	DL	1 I 5
Daily % diseased leaf area increase, g/m ² /d	DISLAP	%DL%	1 R 5 1
Daily leaf area consumed, m ² /m ² /d	LAIDT	DLAI	1 R 5 2
Daily leaf mass consumed, g/m ² /d	WLIDOT	DLFM	1 R 5 2
Daily stem mass consumed, g/m ² /d	WSIDOT	DSTM	1 R 5 2
Daily seed mass consumed, g/m ² /d	SWIDOT	DSDM	1 R 5 2
Daily seed number consumed, #/m ² /d	SDIDOT	DSD#	1 R 5 2
Daily shell mass consumed, g/m ² /d	WSHIDT	DSHM	1 R 5 2
Daily shell number consumed, #/m ² /d	SHIDOT	DSH#	1 R 5 2
Daily root mass consumed, g/m ² /d	WRIDOT	DRTM	1 R 5 2
Daily root length density consumed, cm/cm ³ /d	RLV DOT	DRLV	1 R 5 2

-
- 1 Abbreviations used as variable names in the IBSNAT models.*
 - 2 Abbreviations suggested for use in header lines (those designated with '@') within the file. They correspond to the variable names used in the associated database.*
 - 3 Formats are presented as follows: number of leading spaces, variable type (Character = C, Real = R, Integer = I), variable width, and (if real) number of decimals.*
 - 4 Each new run should be demarcated with '*RUN' at the beginning of this line in each file.*
 - 5 Additional information can be placed between lines 4 and 5, as required by a user, as illustrated in the example, and as documented for the Overview file in the text.*

EXAMPLE PEST OUTPUT FILE

*PEST ASPECTS OUTPUT FILE

```

*RUN   1      : Pest and Diseases
MODEL    : CRGR0940 - PEANUT
EXPERIMENT : UFGA7602 PN      PEANUT PEST TEST 1
TREATMENT 8  : LEAF,STEM,SEED,SHELL MASS

CROP      : PEANUT          CULTIVAR : FLORUNNER          - FLORUNNER VARS
STARTING DATE : MAY  5 1976
PLANTING DATE : MAY  5 1976    PLANTS/m2 : 12.9    ROW SPACING : 31.cm
WEATHER      : UFGA  1976
SOIL         : IBPN910015    TEXTURE :          - Millhopper Fine Sand
SOIL INITIAL C : DEPTH:180cm EXTR. H2O:158.4mm NO3:  .0kg/ha NH4:  0kg/ha
WATER BALANCE : IRRIGATE ACCORDING TO FIELD SCHEDULE
IRRIGATION   :          75 mm IN    4 APPLICATIONS
NITROGEN BAL. : NOT SIMULATED ; NO N-STRESS
N FERTILIZER :
RESIDUE/MANURE :
ENVIRONM. OPT. : DAYL=          .0 SRAD=          .0 TMAX=          .0 TMIN=          .0
                  RAIN=          .0 CO2 = R 330.0 DEW =          .0 WIND=          .0
SIMULATION OPT : WATER      :Y NITROGEN:N N-FIX:Y PESTS :Y PHOTO :C ET :R
MANAGEMENT OPT : PLANTING:R IRRIG :R FERT :R RESIDUE:R HARVEST:R WTH:M

```

@DATE	CDAY	DLA	%DL%	DLAI	DLFM	DSTM	DSDM	DSD#	DSHM	DSH#	DRTM	DRLV
76126	0	0	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00
76129	3	0	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00
76132	6	0	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00
76135	9	0	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00
76138	12	0	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00
76141	15	0	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00
76144	18	0	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00
76147	21	0	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00
76150	24	0	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00
76153	27	39	1.3	.00	.00	.08	.00	.00	.00	.00	.18	.01
76156	30	100	2.5	.00	.00	.12	.00	.00	.00	.00	.42	.03
76159	33	235	3.8	.00	.00	.23	.00	.00	.00	.00	.68	.05
76162	36	459	5.0	.00	.00	.32	.00	.00	.00	.00	1.02	.08
76165	39	648	6.2	.00	.00	.35	.00	.00	.00	.00	1.87	.13
76168	42	794	7.5	.00	.00	.45	.00	.00	.00	.00	2.75	.17
76171	45	1031	8.7	.00	.00	.69	.00	.00	.00	.00	3.46	.22
76174	48	1543	10.0	.00	.00	.81	.00	.00	.00	.00	3.32	.21
76177	51	2313	11.3	.01	.60	1.33	.00	.00	.00	.00	3.31	.20
76180	54	3200	12.5	.02	.75	1.54	.00	.76	.06	.39	3.36	.20
76183	57	4118	13.8	.02	.93	1.79	.07	2.89	.26	1.47	3.16	.19
76186	60	4953	15.0	.02	.87	1.93	.17	5.21	.51	2.61	3.28	.19
76189	63	5869	16.3	.02	.97	2.22	.23	6.53	.67	3.22	3.54	.20
76192	66	6722	17.5	.03	1.13	2.41	.29	8.00	.83	3.88	3.33	.18
76195	69	7412	18.8	.02	.96	2.48	.34	9.66	.99	4.62	4.05	.21
76198	72	7761	20.0	.01	.58	1.81	.35	12.32	1.19	5.80	5.29	.26

CHAPTER FIVE.

EXPERIMENT PERFORMANCE DATA FILES

Experiment performance data are contained in FILEP, FILED, FILEA and FILET, which the user generates using the formats shown in Tables 18 and 19. The correct formatting of FILEA and FILET is critical because these files link directly to the model(s). The purpose of these files is to present measured performance data for direct comparison with simulated results. FILEP is the basic performance data file, with information detailed at the replicate level for each treatment, arranged by plots. FILED would contain replicate performance data arranged by date of observations. In other words, FILEP and FILED are the basic performance data files, with information detailed at the replicate level for each treatment, arranged by plots in FILEP and by date of measurement in FILED. FILEA and FILET contain average values derived from the data in FILEP or FILED. FILEA uses one line of information per treatment and this one line is a summary of information of the entire treatment. The dates included on each line are of the main phenological events and the yield and yield components at final harvest, as well as other related variables. FILET contains one line of data for each observation date for each treatment. Averages are arranged in columns in order of treatment in FILEA, in order of date in the time-course file, FILET. The files will have a variable number of columns, depending on the data available. Each could have as few as one measured variable, or as many variables as measured. Each experimental data file, however, will always have an initial section with the institute and site codes and experiment number, the crop group code, and the experiment name. All columns have one leading blank and five spaces for data, and are headed by standard variable abbreviations (see Appendix C for a listing of abbreviations). Each data column, if appropriate, could also have header lines containing information on the date measurements were made, and on the factor by which data need to be multiplied to convert them to standard units. Examples are shown in Tables 18 and 19.

TABLE 18. EXAMPLE OF AN EXPERIMENT PERFORMANCE DATA AVERAGES FILE (FILEA), STORED IN THE DATA FILE, UFGA8101.SBA.

*EXP.DATA (A): UFGA8101SB COBB, IRRIGATED, VEG. & REPROD. STRESS

@	TRNO	HWAM	HWUM	H#AM	H#UM	LAIX	CWAM	BWAH	ADAT	MDAT	PD1T	PDFT	PWAM
	1	3502.	.1476	2374.	1.88	6.25	6851.	2137.	224	295	243	243	4526.
	2	3355.	.1529	2195.	1.84	4.48	6109.	1587.	225	295	245	245	4403.
	3	2738.	.1292	2119.	1.77	6.25	5881.	2064.	224	295	243	243	3690.

TABLE 19. EXAMPLE OF AN EXPERIMENT TIME-COURSE DATA FILE (FILET), SHOWING TIME SERIES FOR TREATMENT 1, STORED IN THE DATA FILE, UFGA8101.SBT.

*EXP.DATA (T): UFGA8101SB COBB, IRRIGATED, VEG. & REPROD. STRESS

@TRNO	DATE	L#SD	LAID	P#AD	SWAD	GWAD	LWAD	CWAD	PWAD	SHAD	G#AD	SH%D	SLAD
1	81188	.8	.11	0.	18	0.	40	58	0.	0.	0.	00.00	272
1	81190	1.4	.15	0.	20	0.	53	74	0.	0.	0.	00.00	277
1	81196	2.5	.37	0.	70	0.	144	214	0.	0.	0.	00.00	254
1	81204	6.3	1.27	0.	254	0.	350	604	0.	0.	0.	00.00	360
1	81208	6.8	1.75	0.	404	0.	497	901	0.	0.	0.	00.00	351
1	81210	7.1	1.75	0.	437	0.	499	936	0.	0.	0.	00.00	350
1	81212	7.4	1.74	0.	462	0.	525	987	0.	0.	0.	00.00	332
1	81215	7.9	2.48	0.	678	0.	722	1400	0.	0.	0.	00.00	344
1	81219	8.6	3.11	0.	1005	0.	864	1869	0.	0.	0.	00.00	359
1	81223	10.3	3.47	0.	1260	0.	980	2240	0.	0.	0.	00.00	354
1	81225	10.4	4.20	0.	1384	0.	1102	2486	0.	0.	0.	00.00	380
1	81229	10.6	4.57	0.	1758	0.	1317	3075	0.	0.	0.	00.00	348
1	81233	-99	4.33	0.	1896	0.	1206	3102	0.	0.	0.	00.00	357
1	81237	14.1	5.00	50.	2163	0.	1469	3636	4	4	0.	00.00	341
1	81245	14.4	5.87	757.	2704	0.	1717	4510	89	89	0.	00.00	342
1	81246	-99	6.25	-99	2897	0.	1750	4849	202	202	0.	00.00	359
1	81251	11.8	5.34	992.	2639	0.	1657	4657	361	361	0.	00.00	322
1	81252	-99	4.85	-99	2727	0.	1472	4621	421	421	0.	00.00	330
1	81257	15.3	4.49	1467	2940	0.	1704	5504	860	860	0.	00.00	264
1	81259	-99	5.06	-99	3674	0.	1651	6624	1299	1299	0.	00.00	306
1	81261	15.3	4.74	1505	2928	557	1694	5992	1370	813	2918	40.66	280
1	81266	-99	4.50	-99	3270	919	1612	6794	1912	993	3470	48.06	281
1	81267	15.0	4.10	1442	2566	1037	1409	5957	1983	946	2439	52.29	291
1	81271	16.5	3.85	1184	2419	1294	1549	6154	2185	891	2142	59.22	249
1	81273	-99	4.10	-99	2876	1643	1572	6998	2550	907	2511	64.43	261
1	81274	17.3	4.33	1552	3287	2437	1730	8578	3561	1124	3063	68.44	250
1	81278	16.0	3.17	1193	2603	1804	1398	6732	2732	928	2109	66.03	227
1	81280	-99	3.96	-99	2962	2387	1532	7913	3419	1032	2434	69.82	259
1	81287	-99	3.83	-99	3024	3278	1525	8858	4310	1032	2690	76.06	251
1	81294	-99	2.18	-99	2483	3548	810	7869	4576	1028	2469	77.53	268
1	81301	-99	.61	-99	1966	3208	215	6323	4142	934	2223	77.45	287
1	81308	-99	.44	-99	2307	3796	163	7378	4909	1113	2524	77.33	276

CHAPTER SIX.

DISCUSSION

These proposed file structures resulted from the interest in an earlier set of crop model inputs and outputs published by IBSNAT (1986, 1990). The earlier standards have been used for a number of crop models in the integrated software package called DSSAT (Decision Support System for Agrotechnology Transfer). This earlier attempt demonstrated the value of such standards in facilitating the organization and exchange of crop weather, soil, and plot data among modeling and model user groups at various institutions. The inputs and outputs described in this document represent a wider range of crop, weather, and soil conditions, and should be nonspecific to a crop model. By expanding the list of inputs, however, it is more likely that some of the inputs will not be available for all experiments or for all intended applications. This creates a dilemma for modelers, who must decide which of the defined variables are to be a minimum set required to run their models, or must include capabilities in their models to recognize and estimate missing variables. The same is true for outputs. However, this does not create the same difficulty as the lack of inputs; it means that only parts of the models can be validated in any one experiment. Nonetheless, a basic minimum data set is needed for effective interpretation of all experiments, regardless of model validation applications. Such a minimum data set has been defined (IBSNAT, 1988), and vigorous efforts should be made to obtain such information in all experiments. The files described here reflect this minimum data set, and thus form part of an overall system that encompasses forms for data collection in the field, files for data storage, and files for use by various analysis programs. Further changes in the model input component of this system will inevitably have an impact on the other components. The design of the system as an entity makes it easier to accommodate such changes than would be the case if each part was considered separately. It is hoped that such an advantage can be

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maintained and strengthened in the future.

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APPENDIX A.

WEATHER LIST AND SOIL PROFILE LIST FILES

WEATHER LIST FILE

This file contains a list of weather data files which are available for use by the simulation models. It has one line of information (see Table 20, below) for each weather data set which gives the file name, site name, latitude, longitude, and elevation. The actual weather file used for a particular experiment is specified in the experiment file (FILEX). The weather list file typically would be used in sensitivity analysis where a user may wish to examine crop performance under alternate weather conditions.

TABLE 20. EXAMPLE WEATHER LIST FILE. (WTH.LST)

*WEATHER LIST

@#	FILENAME	EXT	SITE NAME.....	LAT.....	LONG....	ELEV.	TAV..	TAMP.
1	CCPA8601	WTH	CIAT, PALMIRA, COLOMBIA	3.5	-76.4	-99	-99.0	-99.0
2	CCPA8701	WTH	CIAT, PALMIRA, COLOMBIA	3.5	-76.4	-99	-99.0	-99.0
3	DTSP8501	WTH	SUPHAN_BURI, THAILAND	14.5	100.1	-99	-99.0	-99.0
4	EBG08701	WTH	CNPAF, GOIANIA, BRAZIL	-16.3	-49.1	-99	-99.0	-99.0
5	IGQU8901	WTH	ICTA, QUEZADA, GUATEMALA	14.3	-90.0	-99	-99.0	-99.0
6	IRMZ8501	WTH	IRRI, MUNOZ, PHILIPPINES	15.7	120.9	-99	-99.0	-99.0
7	IRMZ8601	WTH	IRRI, MUNOZ, PHILIPPINES	15.7	120.9	-99	-99.0	-99.0
8	IRPI8001	WTH	IRRI, PILA, PHILIPPINES	14.2	121.3	50	27.0	3.8
9	IRPI8501	WTH	IRRI, PILA, PHILIPPINES	14.2	121.3	50	27.0	3.8
10	IRPI8601	WTH	IRRI, PILA, PHILIPPINES	14.2	121.3	50	27.0	3.8
11	IUCA7901	WTH	CASTANA, IOWA, USA	42.2	-93.7	-99	-99.0	-99.0
12	KSAS8101	WTH	ASHLAND, KANSAS, USA	39.0	-97.0	-99	-99.0	-99.0
13	UBKA8601	WTH	KAJONDI_FARM, BURUNDI	-3.3	30.0	-99	-99.0	-99.0
14	UFGA7601	WTH	GAINESVILLE, FLORIDA, USA	29.6	-82.4	10	20.9	7.4
15	UFGA7801	WTH	GAINESVILLE, FLORIDA, USA	29.6	-82.4	10	20.9	7.4
16	UFGA7901	WTH	GAINESVILLE, FLORIDA, USA	29.6	-82.4	10	20.9	7.4
17	UFGA8001	WTH	GAINESVILLE, FLORIDA, USA	29.6	-82.4	10	20.9	7.4
18	UFGA8101	WTH	GAINESVILLE, FLORIDA, USA	29.6	-82.4	10	20.9	7.4
19	UFGA8201	WTH	GAINESVILLE, FLORIDA, USA	29.6	-82.4	10	20.9	7.4
20	UFGA8401	WTH	GAINESVILLE, FLORIDA, USA	29.6	-82.4	10	20.9	7.4
21	UFGA8501	WTH	GAINESVILLE, FLORIDA, USA	29.6	-82.4	10	20.9	7.4
22	UFGA8601	WTH	GAINESVILLE, FLORIDA, USA	29.6	-82.4	10	20.9	7.4
23	UFQU7901	WTH	QUINCY, FLORIDA, USA	30.6	-86.4	-99	-99.0	-99.0

SOIL PROFILE LIST FILE

This file contains a list of soil profiles which are available for use by the simulation models. It has one line of information (see Table 21, below) for each soil profile which gives the file name, soil code, texture, depth and description. The actual soil profile used for a particular experiment is specified in the experiment file (FILEX).

TABLE 21. EXAMPLE SOIL PROFILE LIST FILE. (SOL.LST)

*SOIL LIST

@#	FILENAME	EXT	SOIL CODE	TEXTURE	DEPTH	DESCRIPTION
1	SOIL	SOL	GAPN930001	SALO	178	FACEVILLE
2	SOIL	SOL	IBBN910015	FSA	180	MILLHOPPER FINE SAND
3	SOIL	SOL	IBBN910030	-99	209	M3
4	SOIL	SOL	IBBN910038	-99	150	SAN_FERNANDO, QUEZADA
5	SOIL	SOL	IBMZ910014	FSA	180	MILLHOPPER FINE SAND
6	SOIL	SOL	IBPN910015	FSA	180	MILLHOPPER FINE SAND
7	SOIL	SOL	IBRI910001	-99	50	ANDAQUEPTIC HAPLAQUOLL
8	SOIL	SOL	IBRI910002	-99	50	VERTIC TROPAQUEPT
9	SOIL	SOL	IBRI910063	-99	135	UPLAND
10	SOIL	SOL	IBRI910071	-99	51	SUPHAN LOWLAND
11	SOIL	SOL	IBSB910015	FSA	180	MILLHOPPER FINE SAND
12	SOIL	SOL	IBSB910017	SALO	203	ORANGEBURG SANDY LOAM
13	SOIL	SOL	IBSB910026	SILO	180	IDA SILT LOAM
14	SOIL	SOL	IBWH910018	CSI	180	HAYNIE

APPENDIX B.

EXPERIMENT DETAILS CODES

Headers used in the @ line to identify variables are listed first, codes to identify methods, chemicals, etc. are listed next in sections that relate to specific aspects (Chemicals;Crop and weed species;Diseases and pests;Drainage; Environment modification factors; Fertilizers, inoculants and amendments; Harvest components;Harvest size categories;Methods-fertilizer and chemical applications; Methods-irrigation and water management;Methods-soil analysis; Planting materials; Plant distribution; Residues and organic fertilizers; Rotations;Soil texture;and Tillage implements).

The fields in the file are as follows:

CDE The 'universal' code used to facilitate data interchange.

DESCRIPTION A description of the code, with units.

SO The source of the codes (IB=IBSNAT). Codes added by a user should be referenced in this field and the name and address of the person adding the code should be entered as a comment (ie.with a '!' in column 1) below this note. This is important to ensure that information from different workers can be easily integrated. Users adding codes should also ensure that those constructed by adding a number to section code (eg.FE001,CH001) are clearly identified with a letter in the this position (eg.FEK01 for a fertilizer code added by someone with a family name beginning with K).

*Headers

@CDE	DESCRIPTION	SO
ADDRESS	Contact address of principal scientist	IB
C	Crop component number (default = 1)	IB
CDATE	Application date, year + day or days from planting	IB
CHAMT	Chemical application amount, kg ha-1	IB
CHCOD	Chemical material, code	IB
CHDEP	Chemical application depth, cm	IB
CHME	Chemical application method, code	IB
CHNOTES	Chemical notes (Targets, chemical name, etc.)	IB
CNAME	Cultivar name	IB
CNOTES	Cultivar details (Type, pedigree, etc.)	IB
CR	Crop code	IB
CU	Cultivar level	IB
EC02	CO2 adjustment, A,S,M,R + vpm	IB
EDATE	Emergence date, earliest treatment	IB
EDAY	Daylength adjustment, A,S,M,R + h	IB
EDEW	Humidity adjustment, A,S,M,R + oC	IB
EMAX	Temperature (maximum) adjustment, A,S,M,R + oC	IB
EMIN	Temperature (minimum) adjustment, A,S,M,R + oC	IB
ERAD	Radiation adjustment, A,S,M,R + MJ m-2day-1	IB
ERAIN	Precipitation adjustment, A,S,M,R + mm	IB
EWIND	Wind adjustment, A,S,M,R + km day-1	IB
FACD	Fertilizer application/placement, code	IB
FAMC	Ca in applied fertilizer, kg ha-1	IB
FAMK	K in applied fertilizer, kg ha-1	IB
FAMN	N in applied fertilizer, kg ha-1	IB
FAMO	Other elements in applied fertilizer, kg ha-1	IB
FAMP	P in applied fertilizer, kg ha-1	IB
FDATE	Fertilization date, year + day or days from planting	IB
FDEP	Fertilizer incorporation/application depth, cm	IB
FL	Field level	IB
FLDD	Drain depth, cm	IB
FLDS	Drain spacing, m	IB
FLDT	Drainage type, code	IB
FLDB	Obstruction to sun, degrees	IB
FLSA	Slope and aspect, degrees from horizontal plus direction (W, NW, etc.	IB
FLST	Surface stones (Abundance, % + Size, S,M,L)	IB
FMCD	Fertilizer material, code	IB
FOCD	Other element code, e.g.,. MG	IB
HAREA	Harvest area, m-2	IB
HARM	Harvest method	IB
HCOM	Harvest component, code	IB
HDATE	Harvest date, year + day or days from planting	IB
HL	Harvest level	IB

HLEN	Harvest row length, m	IB
HPC	Harvest percentage, %	IB
HRNO	Harvest row number	IB
HSIZ	Harvest size group, code	IB
HSTG	Harvest stage	IB
IAME	Method for automatic applications, code	IB
IAMT	Amount per automatic irrigation if fixed, mm	IB
IC	Initial conditions level	IB
ICBL	Depth, base of layer, cm	IB
ICDAT	Initial conditions measurement date, year + days	IB
ICND	Nodule weight from previous crop, kg ha-1	IB
ICRE	Rhizobia effectiveness, 0 to 1 scale	IB
ICRN	Rhizobia number, 0 to 1 scale	IB
ICRT	Root weight from previous crop, kg ha-1	IB
IDATE	Irrigation date, year + day or days from planting	IB
IDEP	Management depth for automatic application, cm	IB
ID_FIELD	Field ID (Institute + Site + Field)	IB
ID_SOIL	Soil ID (Institute + Site + Year + Soil)	IB
IEFF	Irrigation application efficiency, fraction	IB
IEPT	End point for automatic appl., % of max. available	IB
INGENO	Cultivar identifier	IB
IOFF	End of automatic applications, growth stage	IB
IROP	Irrigation operation, code	IB
IRVAL	Irrigation amount, depth of water/watertable, etc., mm	IB
ITHR	Threshold for automatic appl., % of max. available	IB
MC	Chemical applications level	IB
ME	Environment modifications level	IB
MF	Fertilizer applications level	IB
MH	Harvest level	IB
MI	Irrigation level	IB
MP	Planting level	IB
MR	Residue level	IB
MT	Tillage level	IB
NOTES	Notes	IB
O	Rotation component - option (default = 1)	IB
ODATE	Environmental modification date, year + day or days from planting	IB
PAGE	Transplant age, days	IB
PAREA	Gross plot area per rep, m-2	IB
PCR	Previous crop code	IB
PDATE	Planting date, year + days from Jan. 1	IB
PENV	Transplant environment, ~C	IB
PEOPLE	Names of scientists	IB
PLAY	Plot layout	IB
PLDP	Planting depth, cm	IB
PLDR	Plots relative to drains, degrees	IB
PLDS	Planting distribution, row R, broadcast B, hill H	IB
PLEN	Plot length, m	IB
PLME	Planting method, code	IB
PLOR	Plot orientation, degrees from N	IB
PLPH	Plants per hill (if appropriate)	IB
PLRD	Row direction, degrees from N	IB
PLRS	Row spacing, cm	IB
PLSP	Plot spacing, cm	IB
PLWT	Planting material dry weight, kg ha-1	IB
PPOE	Plant population at emergence, m-2	IB
PPOP	Plant population at seeding, m-2	IB
PRNO	Rows per plot	IB
R	Rotation component - number (default = 1)	IB
RACD	Residue application/placement, code	IB
RAMT	Residue amount, kg ha-1	IB
RCOD	Residue material, code	IB
RDATE	Incorporation date, year + days	IB
RDEP	Residue incorporation depth, cm	IB
RDMC	Residue dry matter content, %	IB
RESK	Residue potassium concentration, %	IB
RESN	Residue nitrogen concentration, %	IB
RESP	Residue phosphorus concentration, %	IB
RINP	Residue incorporation percentage, %	IB
SA	Soil analysis level	IB
SABD	Bulk density, moist, g cm-3	IB
SABL	Depth, base of layer, cm	IB

SADAT	Analysis date, year + days from Jan. 1	IB
SAHB	pH in buffer	IB
SAHW	pH in water	IB
SAKE	Potassium, exchangeable, cmol kg-1	IB
SANI	Total nitrogen, g kg-1	IB
SAOC	Organic carbon, g kg-1	IB
SAPX	Phosphorus, extractable, mg kg-1	IB
SH20	Water, cm3 cm-3	IB
SITE(S)	Name and location of experimental site(s)	IB
SLDP	Soil depth, cm	IB
SLTX	Soil texture	IB
SM	Simulation control level	IB
SMHB	pH in buffer determination method, code	IB
SMKE	Potassium determination method, code	IB
SMPX	Phosphorus determination method, code	IB
SNH4	Ammonium, KCl, g elemental N Mg-1 soil	IB
SN03	Nitrate, KCl, g elemental N Mg-1 soil	IB
TDATE	Tillage date, year + day	IB
TDEP	Tillage depth, cm	IB
TIMPL	Tillage implement, code	IB
TL	Tillage level	IB
TN	Treatment number	IB
TNAME	Treatment name	IB
WSTA	Weather station code (Institute + Site)	IB
*Chemicals (Herbicides, Insecticides, Fungicides, etc.)		
@CDE	DESCRIPTION	SO
CH001	Alachlor (Lasso), Metolachlor (Dual) [Herbicide]	IB
CH002	Propanil [Herbicide]	IB
CH003	Trifluralin [Herbicide]	IB
CH004	Dalapon [Herbicide]	IB
CH005	MCPA [Herbicide]	IB
CH006	2,4-D [Herbicide]	IB
CH007	2,4,5-T [Herbicide]	IB
CH008	Pendimethalin [Herbicide]	IB
CH009	Atrazine [Herbicide]	IB
CH010	Diquat [Herbicide]	IB
CH011	Paraquat [Herbicide]	IB
CH021	Carbaryl, Sevin, Septene [Insecticide]	IB
CH022	Malathion, Mercaptothion [Insecticide]	IB
CH023	Naled [Insecticide]	IB
CH024	Dimethoate [Insecticide]	IB
CH025	Fention [Insecticide]	IB
CH026	Diazinon, Basudin [Insecticide]	IB
CH027	Ethion, Diethion [Insecticide]	IB
CH028	Oxydemeton-Methyl [Insecticide]	IB
CH029	Azinphos-Methyl [Insecticide]	IB
CH030	Phosphamidon [Insecticide]	IB
CH031	Mevinphosl [Insecticide]	IB
CH032	Methyl Parathion [Insecticide]	IB
CH033	Parathion [Insecticide]	IB
CH034	DDT [Insecticide]	IB
CH035	BHC, HCH [Insecticide]	IB
CH036	Chlordane [Insecticide]	IB
CH037	Heptachlor [Insecticide]	IB
CH038	Toxaphene [Insecticide]	IB
CH039	Aldrin [Insecticide]	IB
CH040	Dieldrin [Insecticide]	IB
CH041	Endrin, Nendrin [Insecticide]	IB
CH042	Methomyl, Lannat [Insecticide]	IB
CH043	Thiotex [Insecticide]	IB
CH044	Furadan [Insecticide]	IB
CH045	Endosulfan [Insecticide]	IB
CH051	Captan [Fungicide]	IB
CH052	Benomyl [Fungicide]	IB
CH053	Zineb [Fungicide]	IB
CH054	Maneb [Fungicide]	IB
CH055	Mancozeb [Fungicide]	IB
CH056	Tilt [Fungicide]	IB
CH057	Rhizobium (for legume crops)	IB
*Crop and Weed Species		

@CDE	DESCRIPTION	SO
AR	Aroid	IB
AL	Alfalfa/Lucerne	IB
BA	Barley	IB
BN	Dry bean	IB
BS	Beet sugar	IB
BW	Broad leaf weeds	IB
CO	Cotton	IB
CS	Cassava	IB
FA	Fallow	IB
GW	Grass weeds	IB
ML	Pearl Millet	IB
MZ	Maize	IB
OA	Oats	IB
PN	Peanut	IB
PT	Potato	IB
RI	Rice	IB
SB	Soybean	IB
SC	Sugar Cane	IB
SG	Grain sorghum	IB
ST	Shrubs/trees	IB
WH	Wheat	IB
*Disease and Pest Organisms		
@CDE	DESCRIPTION	SO
!Examples of codes that have been used are given below.		
CEW	Corn earworm (<i>Heliothis zea</i>), no. m-2	IB
VBC	Velvetbean caterpillar (<i>Anticarsia gemmatilis</i>), no. m-2	IB
SBL	Soybean looper (<i>Pseudoplusia includens</i>), no. m-2	IB
SKB	Southern green stinkbug (<i>Mezara viridula</i>), no. m-2	IB
RKN	Root-knot nematode (<i>Meloidogyne</i> spp.), no. cm-3 soil	IB
CUT	Cutworm, no. m-2	IB
*Drainage		
@CDE	DESCRIPTION	SO
DR000	No drainage	IB
DR001	Ditches	IB
DR002	Sub-surface tiles	IB
DR003	Surface furrows	IB
*Environment Modification Factors		
@CDE	DESCRIPTION	SO
A	Add	IB
S	Subtract	IB
M	Multiply	IB
R	Replace	IB
*Fertilizers, Inoculants and Amendments		
@CDE	DESCRIPTION	SO
FE001	Ammonium nitrate	IB
FE002	Ammonium sulfate	IB
FE003	Ammonium-nitrate-sulfate	IB
FE004	Anhydrous ammonia	IB
FE005	Urea	IB
FE006	Diammonium phosphate	IB
FE007	Monoammonium phosphate	IB
FE008	Calcium nitrate	IB
FE009	Aqua ammonia	IB
FE010	Urea ammonium nitrate solution	IB
FE011	Calcium ammonium nitrate solution	IB
FE012	Ammonium polyphosphate	IB
FE013	Single superphosphate	IB
FE014	Triple superphosphate	IB
FE015	Liquid phosphoric acid	IB
FE016	Potassium chloride	IB
FE017	Potassium nitrate	IB
FE018	Potassium sulfate	IB
FE019	Urea super granules	IB
FE020	Dolomitic limestone	IB
FE021	Rock phosphate	IB
FE022	Calcitic limestone	IB

FE024	Rhizobium	IB
FE026	Calcium hydroxide	IB
*Harvest components		
@CDE	DESCRIPTION	SO
C	Canopy	IB
L	Leaves	IB
H	Harvest product	IB
*Harvest size categories		
@CDE	DESCRIPTION	SO
A	All	IB
S	Small - less than 1/3 full size	IB
M	Medium - from 1/3 to 2/3 full size	IB
L	Large - greater than 2/3 full size	IB
*Methods - Fertilizer and Chemical Applications		
@CDE	DESCRIPTION	SO
AP000	Applied when required - no shortage	IB
AP001	Broadcast, not incorporated	IB
AP002	Broadcast, incorporated	IB
AP003	Banded on surface	IB
AP004	Banded beneath surface	IB
AP005	Applied in irrigation water	IB
AP006	Foliar spray	IB
AP007	Bottom of hole	IB
AP008	On the seed	IB
AP009	Injected	IB
AP011	Broadcast on flooded/saturated soil, none in soil	IB
AP012	Broadcast on flooded/saturated soil, 15% in soil	IB
AP013	Broadcast on flooded/saturated soil, 30% in soil	IB
AP014	Broadcast on flooded/saturated soil, 45% in soil	IB
AP015	Broadcast on flooded/saturated soil, 60% in soil	IB
AP016	Broadcast on flooded/saturated soil, 75% in soil	IB
AP017	Broadcast on flooded/saturated soil, 90% in soil	IB
AP018	Band on saturated soil, 2cm flood, 92% in soil	IB
AP019	Deeply placed urea super granules/pellets, 95% in soil	IB
AP020	Deeply placed urea super granules/pellets, 100% in soil	IB
*Methods - Irrigation and Water Management (Units for associated data)		
@CDE	DESCRIPTION	SO
IR001	Furrow, mm	IB
IR002	Alternating furrows, mm	IB
IR003	Flood, mm	IB
IR004	Sprinkler, mm	IB
IR005	Drip or trickle, mm	IB
IR006	Flood depth, mm	IB
IR007	Water table depth, mm	IB
IR008	Percolation rate, mm day-1	IB
IR009	Bund height, mm	IB
*Methods - Soil Analysis		
@CDE	DESCRIPTION	SO
SA001	Olsen	IB
SA002	Bray No. 1	IB
SA003	Bray No. 2	IB
SA004	Mehlich	IB
SA005	Anion exchange resin	IB
SA006	Truog	IB
SA007	Double acid	IB
SA008	Colwell	IB
SA009	Water	IB
SA010	IFDC Pi strip	IB
*Planting Material/Method		
@CDE	DESCRIPTION	SO
PM001	Dry seed	IB
PM002	Transplants	IB
PM003	Vegetative cuttings	IB
PM004	Pregerminated seed	IB

*Plant Distribution		
@CDE	DESCRIPTION	S0
R	Rows	IB
H	Hills	IB
U	Uniform	IB
*Residues and Organic Fertilizer		
@CDE	DESCRIPTION	S0
RE001	Crop residue	IB
RE002	Green Manure	IB
RE003	Barneyard Manure	IB
RE004	Liquid Manure	IB
*Rotation		
@CDE	DESCRIPTION	S0
R0001	Continuous arable crops	IB
R0002	Rotation with forages	IB
*Soil Texture		
@CDE	DESCRIPTION	S0
CLOSA	Coarse loamy sand	IB
CSA	Coarse sand	IB
CSI	Coarse silt	IB
CSALO	Coarse sandy loam	IB
CL	Clay	IB
CLLO	Clay loam	IB
FLO	Fine loam	IB
FLOSA	Fine loamy sand	IB
FSA	Fine sand	IB
FSALO	Fine sandy loam	IB
SICLL	Silty clay loam	IB
LO	Loam	IB
LOSA	Loamy sand	IB
SA	Sand	IB
SACL	Sandy clay	IB
SACLL	Sandy clay loam	IB
SI	Silt	IB
SICL	Silty clay	IB
SILO	Silty loam	IB
SALO	Sandy loam	IB
VFLOS	Very fine loamy sand	IB
VFSA	Very fine sand	IB
VFSAL	Very fine sandy loam	IB
*Tillage Implements		
@CDE	DESCRIPTION	S0
TI002	Tandem disk	IB
TI003	Offset disk	IB
TI004	Oneway disk	IB
TI005	Moldboard plow	IB
TI006	Chisel plow	IB
TI007	Disk plow	IB
TI008	Subsoiler	IB
TI009	Beeder/lister	IB
TI010	Field cultivator	IB
TI011	Row crop cultivator	IB
TI012	Harrow-springtooth	IB
TI013	Harrow-spike	IB
TI014	Rotary hoe	IB
TI015	Roto-tiller	IB
TI016	Row crop planter	IB
TI017	Drill	IB
TI018	Shredder	IB
TI019	Hoe	IB
TI020	Planting stick	IB
TI021	Animal-drawn implement	IB
TI022	Hand	IB
TI023	Manual hoeing	IB

APPENDIX C.

SIMULATED AND FIELD DATA CODES

Codes currently used for both simulated and field data are listed in sections relating to specific model output files. Codes currently only used for field data are listed in a section headed Expdata. Codes are assigned as far as possible in accord with the following convention:

- 1st letter: Plant component (eg. C for canopy; H for harvest product)
- 2nd letter: Measurement aspect (eg. W for dry weight; N for nitrogen weight)
- 3rd letter: Basis of measurement (eg. A for unit area; P for plant)
- 4th letter: Time or stage of measurement (eg. D for specific day)

For complex aspects (eg. ear plus grain) this convention has been modified by dropping the usual 4th letter and using the first 2 letter for component(s). Codes for dates have letters for the stage first and then a D or DAT.

The fields in the file are as follows:

- CDE The 'universal' code used to facilitate data interchange.
- LABEL A short description used when labelling graphs.
- DESCRIPTION A 35 character description of the aspect.
- OTHER CODE(S) Additional codes that may be used locally (eg. YILD for HWAM)
- SO The source of the codes (IB=IBSNAT). Codes added by a user should be referenced in this field and the name and address of the person adding the code should be entered as a comment (ie.with a '!' in column 1) below this note. This is important to ensure that information from different workers can be easily integrated.
- [SE The section to which the code belongs. Used for sorting.]

*SUMMARY

@CDE	LABEL	DESCRIPTION	OTHER CODE(S)	SO	SE
ADAT	ANTHESIS day	Anthesis date (YrDoy)	ANTH	IB	SU
BWAH	BYPRODUCT kg/ha	By-product harvest (kg dm/ha)		IB	SU
CNAA	TOPS N,ANTHESIS	Tops N at anthesis (kg/ha)		IB	SU
CNAM	TOPS N kg/ha	Tops N at maturity (kg/ha)		IB	SU
CPAM	TOPS P kg/ha	Tops P at maturity (kg/ha)		IB	SU
CWAA	TOPS WT,ANTHESIS	Tops weight at anthesis (kg dm/ha)		IB	SU
CWAM	TOPS WT kg/ha	Tops weight at maturity (kg dm/ha)		IB	SU
DRCM	DRAINAGE mm	Season water drainage (mm)		IB	SU
DWAP	SOWING WT kg/ha	Planting material weight (kg dm/ha)		IB	SU
ETCM	ET TOTAL mm	Season evapotranspiration (mm)		IB	SU
FNAM	FIELD NAME	Field name		IB	SU
GN%M	GRAIN N%,MATURE	Grain N at maturity (%)		IB	SU
GNAM	GRAIN N kg/ha	Grain N at maturity (kg/ha)		IB	SU
H#AM	NUMBER #/m2	Number at maturity (no/m2)		IB	SU
H#UM	NUMBER #/unit	Number at maturity (no/unit)		IB	SU
HDAT	HARVEST day	Harvest date (YRDoy)		IB	SU
HIAM	HARVEST INDEX	Harvest index at maturity		IB	SU
HWAH	HAR YIELD kg/ha	Yield at harvest (kg dm/ha)		IB	SU
HWAM	MAT YIELD kg/ha	Yield at maturity (kg dm/ha)		IB	SU
HWUM	WEIGHT mg/unit	Unit wt at maturity (mg dm/unit)		IB	SU
IR#M	IRRIG APPS #	Irrigation applications (no)		IB	SU
IRCM	IRRIG mm	Season irrigation (mm)		IB	SU
L#SM	LEAF NUMBER #	Leaf number per stem,maturity		IB	SU
L#SX	LEAF NUMBER #	Leaf number per stem,maximum		IB	SU
LAIX	LAI MAXIMUM	Leaf area index, maximum		IB	SU
MDAT	MATURITY day	Physiological maturity date (YrDoy)		IB	SU
NFXM	N FIXED kg/h	N fixed during season (kg/ha)		IB	SU
NI#M	N APPLICATION #	N applications (no)		IB	SU
NIAM	SOIL N kg/ha	Inorganic N at maturity (kg N/ha)		IB	SU
NICM	TOT N APP kg/ha	Inorganic N applied (kg N/ha)		IB	SU
NLCM	N LEACHED kg/ha	N leached during season (kg N/ha)		IB	SU
NUCM	N UPTAKE kg/ha	N uptake during season (kg N/ha)		IB	SU
OCAM	ORGANIC C t/ha	Organic soil C at maturity (t/ha)		IB	SU
ONAM	ORGANIC N kg/ha	Organic soil N at maturity (kg/ha)		IB	SU
PD1T	POD 1 DATE yd	Pod 1 date (YrDoy)		IB	SU
PDAT	PLANTING DATE	Planting date (YrDoy)		IB	SU
PDFT	FULL POD DATE	Full pod date (YrDoy)		IB	SU
PO#M	P APPLICATION #	Number of P applications (no)		IB	SU
POCM	P APPLIED kg/ha	P applied (kg/ha)		IB	SU
PRCM	PRECIP mm	Season precipitation (mm)		IB	SU

PWAM	POD WT kg/ha	Pod weight at maturity (kg dm/ha)	IB	SU
RECM	RESIDUE kg/ha	Residue applied (kg/ha)	IB	SU
ROCM	RUNOFF mm	Season surface runoff (mm)	IB	SU
R1AT	FIRST BLOOM	Beginning Bloom Stage	IB	SU
R2AT	FIRST PEG	Beginning Peg Stage	IB	SU
R3AT	FIRST POD	Beginning Pod Stage	IB	SU
R4AT	FULL POD	Full Pod Stage	IB	SU
R5AT	FIRST SEED	Beginning Seed Stage	IB	SU
R6AT	FULL SEED	Full Seed Stage	IB	SU
R7AT	FIRST MATURITY	Beginning Maturity Stage	IB	SU
R8AT	HARV MATURITY	Harvest Maturity Stage	IB	SU
R9AT	OVER-MATURE	Over-Mature Pod Stage	IB	SU
SDAT	SIMULATION DATE	Simulation start date (YrDoy)	IB	SU
SNAM	STEM N, MATURITY	Stem N at maturity (kg/ha)	IB	SU
SPAM	SOIL P kg/ha	Soil P at maturity (kg/ha)	IB	SU
SWXM	EXTR WATER cm	Extractable water at maturity (cm)	IB	SU
THAM	THRESHING %	Threshing % at maturity	IB	SU
TNAM	TREATMENT NAME	Treatment title	IB	SU

*GROWTH				
@CDE	LABEL	DESCRIPTION	LOCAL CODE	SO SE
CDAY	CROP AGE days	Crop age (days from planting)		IB GR
CHTD	CANOPY HEIGHT m	Canopy height (m)		IB GR
CWAD	TOPS WT kg/ha	Tops weight (kg dm/ha)		IB GR
CWID	CANOPY WIDTH m	Canopy width (m; for 1 row)		IB GR
E#AD	EAR NO./m2	Ear number (no/m2)		IB GR
EWAD	EAR WT. kg/ha	Ear (no grain) weight (kg dm/ha)		IB GR
G#AD	GRAIN NO #/m2	Grain number (no/m2)		IB GR
GSTD	GROWTH STAGE	Growth stage		IB GR
GWAD	GRAIN WT kg/ha	Grain weight (kg dm/ha)		IB GR
GWGD	GRAIN WT mg	Unit grain weight (mg dm/grain)		IB GR
HIAD	HARVEST INDEX	Harvest index (grain/top)		IB GR
HIPD	POD INDEX	Pod harvest index (pod/top)		IB GR
L#SD	LEAF NUMBER	Leaf number per stem		IB GR
LAID	LAI	Leaf area index		IB GR
LAWD	SLA cm2/g	Specific leaf area (cm2/g)		IB GR
LN%D	LEAF N %	Leaf nitrogen concentration (%)		IB GR
LWAD	LEAF WT kg/ha	Leaf weight (kg dm/ha)		IB GR
NSTD	N STRESS FACTOR	Nitrogen stress factor (0-1)		IB GR
NWAD	NODULE WT kg/ha	Nodule weight (kg dm/ha)		IB GR
P#AD	POD NO #/m2	Pod number (no/m2)		IB GR
PRSD	SHOOT FRACTION	Partitioning of wt to shoot (ratio)		IB GR
PWAD	POD WT kg/ha	Pod weight (kg dm/ha)		IB GR
PWDD	DETACHED POD WT	Detached pod weight (kg dm/ha)		IB GR
PWTD	POD WT kg/ha	Total pod weight (kg dm/ha)		IB GR
RDPD	ROOT DEPTH m	Root depth (m)		IB GR
RL10	RLD 180-210cm	Root density, 180-210cm (cm/cm3)		IB GR
RL1D	RLD 0-5 cm	Root density, 0-5 cm (cm/cm3)		IB GR
RL2D	RLD 5-15 cm	Root density, 5-15 cm (cm/cm3)		IB GR
RL3D	RLD 15-30 cm	Root density, 15-30 cm (cm/cm3)		IB GR
RL4D	RLD 30-45 cm	Root density, 30-45 cm (cm/cm3)		IB GR
RL5D	RLD 45-60 cm	Root density, 45-60 cm (cm/cm3)		IB GR
RL6D	RLD 60-90 cm	Root density, 60-90 cm (cm/cm3)		IB GR
RL7D	RLD 90-120cm	Root density, 90-120cm (cm/cm3)		IB GR
RL8D	RLD 120-150cm	Root density, 120-150cm (cm/cm3)		IB GR
RL9D	RLD 150-180cm	Root density, 150-180cm (cm/cm3)		IB GR
RN%D	ROOT N %	Root N concentration (%)		IB GR
RWAD	ROOT WT kg/ha	Root weight (kg dm/ha)		IB GR
SH%D	SHELLING %	Shelling % (seed wt/pod wt*100)		IB GR
SHAD	SHELL WT kg/ha	Shell weight (kg dm/ha)		IB GR
SHND	SHELL N %	Shell N concentration (%)		IB GR
SLAD	SLA cm2/g	Specific leaf area (cm2/g)		IB GR
SN%D	STEM N %	Stem (stover) N concentration (%)		IB GR
SWAD	STEM WT kg/ha	Stem weight (kg dm/ha)		IB GR
T#AD	TILLER NO #/m2	Tiller number (no/m2)		IB GR
WSGD	H2O STRESS, GR	Water stress - growth (0-1)		IB GR
WSPD	H2O STRESS, PHS	Water stress - photosynthesis (0-1)		IB GR

*NITROGEN				
@CDE	LABEL	DESCRIPTION	LOCAL CODE	SO SU
AMLS	NH3VOL kgN/ha/d	Ammonia Vol. (kg N/ha/day)		IB NI
CNAD	CROP N kg/ha	Tops N (kg/ha)		IB NI
FALG	ALGAL ACTIVITY	Floodwater Phot.Act.Index (0 to 1)		IB NI
FALI	FLOOD LT INDX	Floodwater Light Index (0 to 1)		IB NI
FDEN	DNITRF kgN/ha/d	Floodwater Denitrif Rt (kg N/ha/d)		IB NI
FL3C	FLD NH3 mg N/l	Floodwater Aqueous NH3 (mg N/l)		IB NI
FL3N	FLD NO3 mg N/l	Floodwater NO3-N (mg N/l)		IB NI
FL4C	FLD NH4 mg N/l	Floodwater NH4-N Conc. (mg N/l)		IB NI
FL4N	FLD NH4 kgN/ha	Floodwater Ammoniacal N (kg N/ha)		IB NI
FLBD	Puddle BD g/cc	Puddled Soil Surface L BD (g/cc)		IB NI
FLEF	Flood Evap mm	Floodwater Evaporation Rate (mm/d)		IB NI
FLNI	FLOOD NIT INDX	Floodwater Nitrogen Index (0 to 1)		IB NI
FLPH	FLOOD pH	Maximum Daytime Floodwater pH		IB NI
FLTI	FLOOD TMP INDX	Floodwater Temp. Index (0 to 1)		IB NI
FLUR	FLD UREA kgN/ha	Floodwater Urea N (kg N/ha)		IB NI
FUHY	UREA HYD kgN/ha	Urea Hydrol Floodwater (kg N/ha/d)		IB NI
GN%D	GRAIN N %	Grain N concentration (%)		IB NI
GNAD	GRAIN N kg/ha	Grain N (kg/ha)		IB NI
LN%D	LEAF N %	Leaf N concentration (%)		IB NI
LNAD	LEAF N kg/ha	Leaf N (kg/ha)		IB NI
NAPC	N APPLIED kg/ha	Inorganic N applied (kg/ha)		IB NI
NFXC	N FIXED kg/ha	N fixed (kg/ha)		IB NI
NFXD	N FIXED kg/ha.d	N fixation rate (kg/ha.day)		IB NI
NH10	NH4 ug/g180-210	NH4 in 180-210cm (ug N/g soil)		IB NI
NH1D	NH4 ug/g 0-5cm	NH4 in 0-5 cm (ug N/g soil)		IB NI
NH2D	NH4 ug/g 5-15cm	NH4 in 5-15 cm (ug N/g soil)		IB NI
NH3D	NH4 ug/g15-30cm	NH4 in 15-30 cm (ug N/g soil)		IB NI
NH4D	NH4 ug/g30-45cm	NH4 in 30-45 cm (ug N/g soil)		IB NI
NH5D	NH4 ug/g45-60cm	NH4 in 45-60 cm (ug N/g soil)		IB NI
NH6D	NH4 ug/g60-90cm	NH4 in 60-90 cm (ug N/g soil)		IB NI
NH7D	NH4 ug/g 90-120	NH4 in 90-120cm (ug N/g soil)		IB NI
NH8D	NH4 ug/g120-150	NH4 in 120-150cm (ug N/g soil)		IB NI
NH9D	NH4 ug/g150-180	NH4 in 150-180cm (ug N/g soil)		IB NI
NHTD	TOTAL NH4 kg/ha	Total soil NH4 (kg N/ha)		IB NI
NI10	NO3 ug/g180-210	NO3 in 180-210cm (ug N/g soil)		IB NI
NI1D	NO3 ug/g 0-5cm	NO3 in 0-5 cm (ug N/g soil)		IB NI
NI2D	NO3 ug/g 5-15cm	NO3 in 5-15 cm (ug N/g soil)		IB NI
NI3D	NO3 ug/g15-30cm	NO3 in 15-30 cm (ug N/g soil)		IB NI
NI4D	NO3 ug/g30-45cm	NO3 in 30-45 cm (ug N/g soil)		IB NI
NI5D	NO3 ug/g45-60cm	NO3 in 45-60 cm (ug N/g soil)		IB NI
NI6D	NO3 ug/g60-90cm	NO3 in 60-90 cm (ug N/g soil)		IB NI
NI7D	NO3 ug/g 90-120	NO3 in 90-120cm (ug N/g soil)		IB NI
NI8D	NO3 ug/g120-150	NO3 in 120-150cm (ug N/g soil)		IB NI
NI9D	NO3 ug/g150-180	NO3 in 150-180cm (ug N/g soil)		IB NI
NIAD	TOTAL N kg/ha	Total soil NO3+NH4 (kg N/ha)		IB NI
NITD	TOTAL NO3 kg/ha	Total soil NO3 (kg N/ha)		IB NI
NLCC	N LEACHED kg/ha	N leached (kg N/ha)		IB NI
NOAD	ORGANIC N kg/ha	Organic N in soil (kg N/ha)		IB NI
NUPC	N UPTAKE kg/ha	N uptake (kg N/ha)		IB NI
OXRN	OXNITR kgN/ha/d	Ox Layer Nitrif Rt (kg N/ha/d)		IB NI
RN%D	ROOT N %	Root N concentration (%)		IB NI
SHND	SHELL N %	Shell N concentration (%)		IB NI
SN%D	STEM N %	Stem (stover) N concentration (%)		IB NI
SNAD	STEM N kg/ha	Stem N (kg/ha)		IB NI
VN%D	VEG N %	Veg (stem+leaf) N concentration (%)		IB NI
VNAD	VEGE N kg/ha	Veg (stem+leaf) N (kg/ha)		IB NI
*WATER				
@CDE	LABEL	DESCRIPTION	LOCAL CODE	SO SE
DA3D	DAYLENGTH h	Daylength (h;3 deg basis)		IB WA
DAYD	DAYLENGTH h	Daylength (h;sunrise to sunset)		IB WA
DRNC	DRAINAGE mm	Cumulative drainage (mm)		IB WA
EOAA	POT EVAP mm/d	Av pot.evapotranspiration (mm/d)		IB WA
EOAD	POT EVAP mm/d	Potential evapotranspiration (mm/d)		IB WA
EPAA	PLANT EVAP mm/d	Av plant transpiration (mm/d)		IB WA
EPAC	TRANSPIRATION	Cumulative transpiration (mm)		IB WA
EPAD	PLANT EVAP mm/d	Plant transpiration (mm/d)		IB WA
ESAA	SOIL EVAP mm/d	Av soil evaporation (mm/d)		IB WA
ESAC	SOIL EVAP mm	Cumulative soil evaporation (mm)		IB WA

ESAD	SOIL EVAP	mm/d	Soil evaporation (mm/d)	IB	WA
ETAA	EVAPOTRANS	mm/d	Av evapotranspiration (mm/d)	IB	WA
ETAC	EVAPOTRANS	mm	Cumulative evapotranspiration (mm)	IB	WA
ETAD	EVAPOTRANS	mm/d	Evapotranspiration (mm/d)	IB	WA
IR#C	IRRIGATION	#	Irrigation applications (no)	IB	WA
IRRC	IRRIGATION	mm	Cumulative irrigation (mm)	IB	WA
PREC	PRECIPITATION		Cumulative precipitation (mm)	IB	WA
ROFC	RUNOFF	mm	Cumulative runoff (mm)	IB	WA
SRAA	SRAD	MJ/m2.day	Av solar radiation (MJ/m2.day)	IB	WA
SW10	SWC	180-210cm	Soil water 180-210cm (cm3/cm3)	IB	WA
SW1D	SWC	0-5 cm	Soil water 0-5 cm (cm3/cm3)	IB	WA
SW2D	SWC	5-15 cm	Soil water 5-15 cm (cm3/cm3)	IB	WA
SW3D	SWC	15-30 cm	Soil water 15-30 cm (cm3/cm3)	IB	WA
SW4D	SWC	30-45 cm	Soil water 30-45 cm (cm3/cm3)	IB	WA
SW5D	SWC	45-60 cm	Soil water 45-60 cm (cm3/cm3)	IB	WA
SW6D	SWC	60-90 cm	Soil water 60-90 cm (cm3/cm3)	IB	WA
SW7D	SWC	90-120cm	Soil water 90-120cm (cm3/cm3)	IB	WA
SW8D	SWC	120-150cm	Soil water 120-150cm (cm3/cm3)	IB	WA
SW9D	SWC	150-180cm	Soil water 150-180cm (cm3/cm3)	IB	WA
SWXD	EXTR WATER	cm	Extractable water (cm)	IB	WA
TMNA	MINIMUM TEMP	C	Av minimum temperature (C)	IB	WA
TMXA	MAXIMUM TEMP	C	Av maximum temperature (C)	IB	WA
TS10	S-TMP	80-210cm	Soil temperature 180-210cm (C)	IB	WA
TS1D	S-TMP	0-5 cm	Soil temperature 0-5 cm (C)	IB	WA
TS2D	S-TMP	5-15 cm	Soil temperature 5-15 cm (C)	IB	WA
TS3D	S-TMP	15-30 cm	Soil temperature 15-30 cm (C)	IB	WA
TS4D	S-TMP	30-45 cm	Soil temperature 30-45 cm (C)	IB	WA
TS5D	S-TMP	45-60 cm	Soil temperature 45-60 cm (C)	IB	WA
TS6D	S-TMP	60-90 cm	Soil temperature 60-90 cm (C)	IB	WA
TS7D	S-TMP	90-120cm	Soil temperature 90-120cm (C)	IB	WA
TS8D	S-TMP	120-150cm	Soil temperature 120-150cm (C)	IB	WA
TS9D	S-TMP	150-180cm	Soil temperature 150-180cm (C)	IB	WA

* CARBON

@CDE	LABEL	DESCRIPTION	LOCAL CODE	SO	SE
CGRD	CGR g/m2.d	Crop growth rate (g top+store/m2.d)		IB	CA
CHAD	CH20 g/m2.d	CH20 accumulation (g CH20/m2.d)		IB	CA
CL%D	LEAF C %	C in leaf (%)		IB	CA
CMAD	CH MOB g/m2.d	C mobilization (g CH20/m2.d)		IB	CA
CS%D	STEM C %	C in stem (%)		IB	CA
GRAD	GR RESP g/m2.d	Growth respiration (g CH20/m2.d)		IB	CA
LI%D	LIGHT INTER %	Light (PAR) interception (%)		IB	CA
LI%N	NOON LIGHT IN %	Noon light (PAR) interception (%)		IB	CA
LMHN	NOON PMAX, SHADE	Noon Pmax shaded leaves (mg/m2.s)		IB	CA
LMLN	NOON PMAX, LIGHT	Noon Pmax sunlit leaves (mg/m2.s)		IB	CA
MRAD	M RESP g/m2.d	Maintenance resp (g CH20/m2.d)		IB	CA
N%HN	NOON N, SHADE %	Noon N shaded leaves (%)		IB	CA
N%LN	NOON N, LIGHT %	Noon N sunlit leaves (%)		IB	CA
OMAC	OM APPL kg/ha	Cumulative OM applied (kg dm/ha)		IB	CA
PHAD	P GROSS g/m2.d	Gross photosynthesis (g CH20/m2.d)		IB	CA
PHAN	PG, NOON mg/m2.s	Gross photosyn., noon (mg CO2/m2.s)		IB	CA
SLHN	NOON SLW, SHADE	SLW in shaded lves, noon (mg dm/cm2)		IB	CA
SLLN	NOON SLW, Light	SLW in sunlit lves, noon (mg dm/cm2)		IB	CA
SODC	SOIL OC t/ha	Soil organic carbon (t/ha)		IB	CA
TGAV	AVG CAN TMP, C	Daily average canopy temp (C)		IB	CA
TGNN	NOON CAN TMP, C	Noon canopy temperature (C)		IB	CA
TWAD	TOTAL WT ka/ha	Tops+roots+storage wt (ka dm/ha)		IB	CA

*PESTS

@CODE LABEL	DESCRIPTION	LOCAL CODE	SO SE
CASM ASSIM g CH20	Cumulative assimilate reduction		IB PE
CEW CEW #/row-m	Corn Earworm		IB PE
CLAI LAI m2/m2	Cumulative leaf area consumed		IB PE
CLFM LEAF g/m2	Cumulative leaf mass consumed		IB PE
CP0% PLTPOP %	Cumulative pl population reduction		IB PE
CRLF ROOT cm/cm2	Cumulative root length consumed		IB PE
CRLV ROOT cm/cm2	Cumulative root ln density consumed		IB PE
CRTM ROOT g/m2	Cumulative root mass consumed		IB PE
CSD# SEED #/m2	Cumulative seed number consumed		IB PE
CSDM SEED g/m2	Cumulative seed mass consumed		IB PE
CSH# SHELL #/m2	Cumulative shell number consumed		IB PE

CSHM	SHELL g/m2	Cumulative shell mass consumed	IB	PE
CSTM	STEM g/m2	Cumulative stem mass consumed	IB	PE
DASM	ASSIM g CH20/d	Daily carbohydrate pool reduction	IB	PE
DLA	DIS. LAI cm2/m2	Daily diseased leaf area increase	IB	PE
DLA%	DIS. LAI %/d	Daily % diseased leaf area increase	IB	PE
DLAI	LAI m2/m2.d	Daily leaf area consumed	IB	PE
DLFM	LEAF g/m2.d	Daily leaf mass consumed	IB	PE
DPO%	PLTPOP %/day	Daily plant population reduction	IB	PE
DRLF	ROOT cm/cm2.d	Daily total root length consumed	IB	PE
DRLV	ROOT cm/cm3.d	Daily root length density consumed	IB	PE
DRTM	ROOT g/m2.d	Daily root mass consumed	IB	PE
DSD#	SEED #/m2.d	Daily seed number consumed	IB	PE
DSDM	SEED g/m2.d	Daily seed mass consumed	IB	PE
DSH#	SHELL #/m2.d	Daily shell number consumed	IB	PE
DSHM	SHELL g/m2.d	Daily shell mass consumed	IB	PE
DSTM	STEM g/m2.d	Daily stem mass consumed	IB	PE
FAW	FAW #/m	Fall armyworm	IB	PE
RTWM	RTWM #/m	Root worm	IB	PE
SGSB	SGSB #/m	Southern green stinkbug	IB	PE
SL	SB LOOPER #/m	Soybean looper	IB	PE
VBC5	VBC5 #/m	5 instar velvetbean caterpillar	IB	PE
VBC6	VBC6 #/m	6 instar velvetbean caterpillar	IB	PE

*EXPERIMENTAL DATA

@CDE	LABEL	DESCRIPTION	LOCAL CODE	SO	SE
AP1D	APEX 1cm day	Apex 1cm date (YrDoy)		IB	EX
CHN%	CHAFF N %	Chaff N (%)		IB	EX
CHWA	CHAFF WT kg/ha	Chaff weight (kg dm/ha)		IB	EX
DRID	DOUBLE RIDGES d	Double ridges date (YrDoy)		IB	EX
DWAD	DEAD WT kg/ha	Dead material weight (kg dm/ha)		IB	EX
EDAT	EMERGENCE day	Emergence date (YrDoy)		IB	EX
EEMD	EAR EMERGENCE d	Ear emergence date (YrDoy)		IB	EX
EGWA	EAR+GRAIN kg/ha	Ear plus grain weight (kg dm/ha)		IB	EX
EGWS	EAR+GRAIN g/s	Ear+grain weight (g dm/shoot)		IB	EX
G#PD	GRAIN NO #/pl	Grain number (no/plant)		IB	EX
G#SD	GRAIN NO #shoot	Grain number (no/shoot)		IB	EX
GW%M	GRAIN H2O %	Grain moisture at maturity (%)		IB	EX
GWAM	GRAIN WT kg/ha	Grain wt at maturity (kg dm/ha)		IB	EX
GWGM	GRAIN WT mg	Unit wt at maturity (mg dm/grain)		IB	EX
GWPM	GRAIN WT g/pl	Grain wt at maturity (g dm/plant)		IB	EX
GYAM	GRAIN YLD kg/ha	Grain yield at maturity (kg fm/ha)		IB	EX
GYPM	GRAIN YLD g/pl	Grain yld at maturity (g fm/plant)		IB	EX
GYVM	TEST WT kg/hl	Test weight at maturity (kg fm/hl)		IB	EX
HWAC	COR YIELD kg/ha	Corrected yield (kg dm/ha)		IB	EX
HYAM	HARVEST kg/ha	Harvest yld at maturity (kg fm/ha)		IB	EX
LAFD	FLAG AREA cm2	Flag leaf area (cm2/leaf)		IB	EX
LALD	LEAF AREA cm2	Leaf area (cm2/leaf)		IB	EX
LAPD	LEAF AREA cm2/p	Leaf area (cm2/plant)		IB	EX
LARD	LEAF APPEARANCE	Leaf appearance rate (#/day)		IB	EX
L#IR	LEAF # INCREASE	Leaf number increase rate (#/day)		IB	EX
LDAD	DEAD LEAF kg/ha	Dead leaf weight (kg dm/ha)		IB	EX
LF3D	LEAF 3 FULL day	Full expansion, leaf 3 (Yrday)		IB	EX
LF5D	LEAF 5 FULL day	Full expansion, leaf 5 (Yrday)		IB	EX
LLFD	LAST LEAF day	Last leaf date (YrDoy)		IB	EX
LWAM	LEAF WT kg/ha	Leaf weight (kg/ha)		IB	EX
LWPD	LEAF WT g/plant	Leaf weight (g/plant)		IB	EX
PARI	PAR INTERCEPT %	PAR interception (%)		IB	EX
RLAD	ROOT LN cm/cm2	Root length (cm/cm2)		IB	EX
RLWD	ROOT L/W cm/g	Root length/weight (cm/g)		IB	EX
RWLD	ROOT W/L g/cm	Root weight/length (g/cm)		IB	EX
S#PD	SHOOT NO #/pl	Shoot (apex) number (no/plant)		IB	EX
S#AD	SHOOT NO #/m2	Shoot (apex) number (no/m2)		IB	EX
SCWA	STM+CHAFF kg/ha	Stem plus chaff (kg/ha)		IB	EX
SP#P	SPIKELETS #/pl	Spikelet number (no/plant)		IB	EX
SWPD	STEM WT g/plant	Stem weight (g dm/plant)		IB	EX
T#PD	TILLER NO.#/pl	Tiller number (no/plant)		IB	EX
T#AD	TILLER NO.#/m2	Tiller number (no/m2)		IB	EX
TNAM	TOTAL N kg/ha	Total N at maturity (kg N/ha)		IB	EX
TSPD	TERMINAL SPKL d	Terminal spikelet date (YrDoy)		IB	EX
TWAM	TOTAL WT kg/ha	Total wt, maturity (kg dm/ha)		IB	EX
VWAM	VEG WT kg/ha	Veg (lf+st) wt,maturity (kg dm/ha)		IB	EX

Z21D	ZADOKS	21 day	Zadoks 21 date (YrDoy)	IB EX
Z30D	ZADOKS	30 day	Zadoks 30 date (YrDoy)	IB EX
Z31D	ZADOKS	31 day	Zadoks 31 date (YrDoy)	IB EX
Z37D	ZADOKS	37 day	Zadoks 37 date (YrDoy)	IB EX
Z39D	ZADOKS	39 day	Zadoks 39 date (YrDoy)	IB EX
TDWA	TOTAL+D	kg/ha	Tops+roots+storage+dead (kg dm/ha)	IB EX
CDWA	CANOPY+D	kg/ha	Tops+dead wt (kg dm/ha)	IB EX
LALN	LEAF AREA,NEW		Leaf area,new leaves (cm2 lf-1)	IB EX
BR1D	BRANCH 1	YrDoy	Branch 1 date (YrDoy)	IB EX
BR2D	BRANCH 2	YrDoy	Branch 1 date (YrDoy)	IB EX
BR3D	BRANCH 3	YrDoy	Branch 1 date (YrDoy)	IB EX
BR4D	BRANCH 4	YrDoy	Branch 1 date (YrDoy)	IB EX
SDWT	SEED WT	g/pl	Seed weight (g pl-1)	IB EX
HWAD	YIELD	kg/ha	Yield on specified day (kg dm/ha)	IB EX

APPENDIX D.

WEATHER DATA CODES

Headers used in the @ line to identify variables are listed first; codes ('flags') used to designate data types are listed next.

The fields in the file are as follows:

CDE The 'universal' code used to facilitate data interchange.

DESCRIPTION A description of the code, with units.

SO The source of the codes (IB=IBSNAT). Codes added by a user should be referenced in this field and the name and address of the person adding the code should be entered as a comment (ie.with a '!' in column 1) below this note. This is important to ensure that information from different workers can be easily integrated.

*Headers

@CDE	DESCRIPTION	SO
ALPHA	WGEN parameter	IB
ANGA	Angstrom 'a' coefficient	IB
ANGB	Angstrom 'b' coefficient	IB
DATE	Date, year + days from Jan. 1	IB
DEWP	Dewpoint temperature, ~C	IB
DURN	Duration of summarization period for climate files, Yr	IB
ELEV	Elevation, m	IB
GSDU	Growing season duration, Day	IB
GSST	Growing season start day, Doy	IB
IN	Institute code	IB
LAT	Latitude, degrees (decimals)	IB
LONG	Longitude, degrees (decimals)	IB
MONTH	Month, #	IB
NAMN	Temperature minimum,monthly average, C	IB
NASD	WGEN parameter	IB
PAR	Photosynthetic radiation, moles m-2 day-1	IB
PDW	WGEN parameter	IB
RAIN	Rainfall (incl.snow), mm day-1	IB
RAIY	Rainfall,yearly total, mm	IB
REFHT	Reference height for weather measurements, m	IB
RHUMM	Relative humidity average over whole day for month, %	IB
RNUM	Rainy days, # month-1	IB
RTOT	Rainfall total, mm month-1	IB
SAMN	Solar radiation,monthly average, MJ m-2 d-1	IB
SDMN	WGEN parameter	IB
SDSD	WGEN parameter	IB
SI	Site code	IB
SRAD	Solar radiation, MJ m-2 day-1	IB
SRAY	Solar radiation,yearly average, MJ m-2 day-1	IB
START	Start of summary period for climate (CLI) files, Year	IB
SWMN	WGEN parameter	IB
SWSD	WGEN parameter	IB
TAMP	Temperature amplitude, monthly averages, ~C	IB
TAV	Temperature average for whole year, ~C	IB
TMAX	Temperature maximum, ~C	IB
TMIN	Temperature minimum, ~C	IB
WIND	Wind speed average, m sec-1	IB
WINDM	Windspeed average over whole day for month, m s-1	IB
WNDHT	Reference height for windspeed measurements, m	IB
WRUN	Wind run, km day-1	IB
XAMN	Temperature maximum,monthly average, C	IB
XDMN	WGEN parameter	IB
XDSD	WGEN parameter	IB
XWMN	WGEN parameter	IB
XWSD	WGEN parameter	IB

***Flags**

Flags attached to data to indicate the nature of the original data. Upper case flags = original data replaced; lower-case flags = original data.

@CDE	DESCRIPTION	SO
A	Above maximum - data replaced	IB
a	Above maximum - but original data left	IB
B	Below minimum - data replaced	IB
b	Below minimum - - but original data left	IB
D	Decadal averages only in original file - data replaced	IB
d	Decadal averages only in original file - but original data left	IB
E	Format error in original file - data replaced	IB
e	Format error in original file - but original data left	IB
H	Solar radiation as sunshine hours - data replaced	IB
h	Solar radiation as sunshine hours - but original data left	IB
M	Monthly averages only in original file - data replaced	IB
m	Monthly averages only in original file - but original data left	IB
N	No data in original file - data replaced	IB
n	No data in original file - but original data left	IB
R	Rate of change exceeded - data replaced	IB
r	Rate of change exceeded - but original data left	IB

VOLUME 2-2

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CROPGRO-SOYBEAN

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CROPSIM-CASSAVA

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PREFACE

The information presented in the example and output sections of this Part is representative of the results you can produce from your copy of the DSSAT v3 crop models. These are examples only, however, and your results may vary slightly from the results you receive, due to the evolutionary nature of the crop models. Incremental improvements, many suggested by users as they calibrate and validate the models with their own data sets, are constantly being evaluated and implemented. Therefore, post-press changes to the models may reflect improvements implemented after printing of this Volume.

CHAPTER ONE.

INTRODUCTION

The crop models developed under the auspices of the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) Project are process oriented computer models which simulate growth, development, and yield as a function of plant genetics, weather and soil conditions, and crop management selections. These include models for the following crops: aroids (*Colocasia esculenta* L. [taro] & *Xanthosoma sagittifolium* L.[tannier]), barley (*Hordeum vulgare* L.), cassava (*Manihot esculenta* L.), corn (*Zea mays* L.), dry bean (*Phaseolus vulgaris* L.), millet (*Pennisetum americanum* L.), peanut (*Arachis hypogea* L.), potato (*Solanum tuberosum* L.), rice (*Oryza sativa* L.), sorghum (*Sorghum bicolor* L.), soybean (*Glycine max* [L.] Merr.) and wheat (*Triticum eastivum* L.). In the Decision Support System for Agrotechnology Transfer (DSSAT) v2.1 (IBSNAT 1989; Jones et al. 1990) individual models existed for each crop (Table 1). As part of the move to DSSAT v3, crop models were combined to avoid coding duplication and other problems associated with model improvement. For the family of grain legume crops a generic model was developed called CROPGRO, which is being extended to include other crops, such as tomato. The grain cereals, except for CERES-Rice, were combined into a generic grain cereal model called CERES. Development of the root crop models will continue as separate models.

Previously, individual user's guides were developed for the crop models SOYGRO (Jones et al., 1989), PNUTGRO (Boote et al., 1989), BEANGRO (Hoogenboom et al., 1991), CERES-Wheat (Godwin et al., 1989), CERES-Maize (Ritchie et al., 1989), CERES-Barley (Otter-Nacke et al., 1991), and CERES-Rice (Singh et al., 1993). In DSSAT v3, one model user-interface was developed for use by all crop models, and thus, one user's guide.

Since, however, these crop models can also be run as stand-alone models, there is some flexibility as to how the executables, input and output files are organized on a computer disk. The organization of these files for running under both the DSSAT v3 Shell (Volume 1-3, Hunt et al. 1994) and as stand alones is described in Appendix C of this Part.

The operation of the crop models in DSSAT v3 using the DSSAT v3 Shell (Volume 1-3, Hunt et al. 1994) interface is described herein.

TABLE 1. OLD AND NEW GENERATION CROP SIMULATION MODELS.

Crop	DSSAT v2.1 Model	DSSAT v3 Model	Reference
Cereals			
Barley	CERES-Barley	Generic CERES	Otter-Nacke et al. (1991)
Corn (Maize)	CERES-Maize	Generic CERES	Ritchie et al.(1989)
Millet	CERES-Millet	Generic CERES	Singh et al. (1991)
Rice	CERES-Rice	CERES-Rice	Singh et al. (1993)
Sorghum	CERES-Sorghum	Generic CERES	Alargarswamy and Ritchie (1991)
Wheat	CERES-Wheat	Generic CERES	Godwin et al. (1989)
Grain Legumes			
Dry bean	BEANGRO	CROPGRO	Hoogenboom et al (1994)
Peanut	PNUTGRO	CROPGRO	Boote et al. (1989)
Soybean	SOYGRO	CROPGRO	Jones et al. (1989)
Roots and Tubers			
Aroids	SUBSTOR-Aroids	N/A	Prasad et al. (1991)
Cassava	N/A	CROPSIM-Cassava	Matthews and Hunt (1994)
Potato	SUBSTOR-Potato	N/A	Griffin et al. (1993)

CHAPTER TWO.

INPUTS AND OUTPUTS

The DSSAT v3 crop models incorporate the input and output ASCII file structures fully described in Volume 2-1 (Jones et al. 1994) of this book. This I/O system is considerably different than the crop model inputs and outputs structures found in DSSAT v2.1 (IBSNAT 1989, 1990).

WEATHER

Though daily weather formats are similar to those in DSSAT v2.1, additional features have been added to accommodate improved quality control of weather data. A space has been designated next to each data field for characters to document when data were filled from other sources and the reason for filling. The quality control options for weather data in DSSAT v3 are handled by WeatherMan, described in Volume 3-3 (Hansen et al. 1994) of this book. In the DSSAT v3 crop models, including CROPGRO and CERES, the name of the weather file is constructed internally from the weather file information contained in the experiment input file. The code for the weather file includes eight characters, such as UFGA8101, and the file UFGA8101.WTH would be constructed in the model code if observed weather data would be used as input, or the file UFGA8101.WTG would be constructed in the model code if externally generated weather data would be used as input. The model will look first in the current directory for this file. If the model is unable to locate the weather file in the current crop model data directory, the model will check the path specified by the DSSAT v3 path-declaration file (DSSATPRO.FLE). For a complete description of the weather file (FILEW) formats and structures, see Volume 2-1 (Jones et al. 1994) of this book.

SOIL

The soil file has also been changed in DSSAT v3. First, more information was added in an attempt to make the soil inputs more generally applicable by other crop models. For example, clay and silt percentages are now included, and new inputs were defined to allow for simulation of soil phosphorus dynamics. The first release of the DSSAT v3 models will not include the phosphorus module in any of the crop models. Secondly, all new models use the same soil file, whereas models in DSSAT V2.1 required a separate soil file for each crop. The new soil file is usually named SOIL.SOL, but the models will accept soil profile data in input files specific for each

In DSSAT v3, details of a crop experiment, such as field information, treatments, planting information, initial conditions, irrigation, residue and fertilizer management, and harvest information are contained in one single file. This single file is referred to as experiment details file or FILEX. A user can name FILEX based on institute id, site id, year, experiment number, and crop code; the naming convention is similar to the one of DSSAT V2.1 (IBSNAT, 1989; 1990). For example, the file UFGA8101.SBX is the file name for a soybean experiment conducted in 1981 at the University of Florida in Gainesville (UFGA). The experiment details file FILEX is divided into sections; a “*” designates each section, and the file uses the symbol “@” in column 1 of lines that contain codes or headers for variables defined in the section following this header line. The file uses “!” to define comment lines; blank lines can also be used in the file to delineate data input blocks and these lines are ignored by the model when reading the experiment details file. For a complete description of the experiment details file (FILEX) formats and structures, see Volume 2-1 (Jones et al. 1994) of this book.

SIMULATION CONTROL

The DSSAT v3 models use two files for field observed data and other related information. The first file contains averages of field observations, and this information is used for comparison between model simulated data and field observed

TABLE 2. AVERAGE FINAL FIELD DATA FILE. (FILEA = “UFGA7801.SBA”)

*EXP.DATA (A): UFGA7801SB BRAGG, IRRIGATED & NON-IRRIGATED

@TRNO	HWAM	HWUM	H#AM	H#UM	LAIX	CWAM	BWAH	ADAT	MDAT	PD1T	PDFT	PWAM	HIAM	THAM
1	3041.	.1440	2223.	1.96	4.67	6068.	1958.	211	282	233	233	4009.	.501	75.85
2	1178.	.1230	969.	1.85	4.50	3491.	1756.	211	282	233	233	1602.	.337	73.53

data to calibrate, validate and test the models. The field average observational data file is called FILEA. For the example used in the Crop Management section above, this file would be called UFGA8101.SBA. The format for FILEA in DSSAT v3 is different from the format of FILEA in DSSAT v2.1. Generally, the data in FILEA are in stored in columns, which are each 6 characters in width, with a header above each column indicating the type of data in that column. The crop model uses the same header information for its outputs, so that corresponding simulated and observed data can be matched regardless of the location of these columns in the input files. An abbreviation file (DATA.CDE) defines these headers, including appropriate units of the variables and values associated with those headers. These abbreviations are also used by the data handling components of DSSAT v3, graphics, and seasonal and sequence analysis programs. An example of a FILEA is shown in Table 2. For a description of FILEA formats and structures, see Volume 2-1 (Jones et al. 1994) of this book.

TIME-COURSE FIELD DATA

In addition to FILEA, a second file is used to store field data for within-season measurements. This time-course data file, FILET, can contain an unlimited number of 6-character columns. Data that were measured in the field can be stored in this file, and these can include both measured soil, plant, and pest information as a function of day of year. For example FILET, e.g. UFGA8101.SBT, is the time course file for an experiment conducted the University of Florida in Gainesville in 1981. An example of a FILET is shown in Table 3. For a description of FILET formats and structures, see Volume 2-1 (Jones et al. 1994) of this book.

OUTPUT FILES

Outputs from the models are written to the following files:

OVERVIEW.OUT which contains a copy of the output as shown on the computer screen during the simulation;

FILES.GROWTH.OUT, WATER.OUT, NITROGEN.OUT, CARBON.OUT, and PEST.OUT contain time-series outputs at steps as small as one day or as large as specified by the user. Each file can be switched on or off, and the frequency of daily outputs can be specified in the Simulation Control section of FILEX. These output files are temporary and are erased and overwritten at the start of each new simulation run. Users, however, can select an option to save these files with experiment specific file names. This option can be fixed permanently through one variable in FILEX or interactively through the Sensitivity Analysis option. For example, the above described 1981 University of Florida experiment output files could be saved as UFGA8101.SBO, UFGA8191.SBS, UFGA8191.SBG, UFGA8101.SBW, UFGA8101.SBN, UFGA8101.SBC, and UFGA8101.SBD, respectively. For a description of these file formats and structures, see Volume 2-1 (Jones et al. 1994) of this book

TABLE 3. TIME-COURSE FIELD DATA FILE. (FILET = "UFGA7801.SBT")

*EXP.DATA (T): UFGA7801SB BRAGG, IRRIGATED & NON-IRRIGATED

@TRNO	DATE	LAID	SWAD	GWAD	LWAD	CWAD	PWAD	SHAD	SH%D	SLAD	HIAD
1	78194	.89	178	0.	266	444	0.	0.	0.00	334.6	0.000
1	78201	1.28	300	0.	366	667	0.	0.	0.00	349.7	0.000
1	78208	1.91	551	0.	656	1207	0.	0.	0.00	291.2	0.000
1	78215	2.86	943	0.	843	1786	0.	0.	0.00	339.3	0.000
1	78222	4.17	1561	0.	1187	2748	0.	0.	0.00	351.3	0.000
1	78229	3.90	1956	0.	1204	3160	0.	0.	0.00	323.9	0.000
1	78236	4.66	2947	0.	1723	4792	123	123	0.00	270.5	0.000
1	78243	4.47	3144	0.	1772	5224	308	308	0.00	252.3	0.000
1	78250	4.44	3303	182	1631	5740	805	623	22.60	272.2	0.030
1	78257	3.99	3326	754	1568	6507	1613	859	46.75	254.5	0.116
1	78264	4.67	3657	1912	1769	8586	3161	1249	60.49	264.0	0.222
1	78271	2.83	2732	2223	1180	7144	3232	1009	68.78	239.8	0.311
1	78278	2.09	2515	2730	858	7136	3763	1033	72.55	243.6	0.383
1	78285	.47	1851	2913	170	5866	3845	932	75.76	276.5	0.497
1	78292	.09	2064	3169	34	6270	4172	1003	75.96	264.7	0.505
2	78194	.75	160	0.	244	405	0.	0.	0.00	307.4	0.000
2	78201	1.08	251	0.	311	563	0.	0.	0.00	347.3	0.000
2	78208	1.81	535	0.	626	1161	0.	0.	0.00	289.1	0.000
2	78215	3.29	1080	0.	974	2054	0.	0.	0.00	337.8	0.000
2	78222	4.38	1663	0.	1261	2923	0.	0.	0.00	347.3	0.000
2	78229	4.30	2083	0.	1392	3475	0.	0.	0.00	308.9	0.000
2	78236	4.21	2556	0.	1517	4184	112	112	0.00	277.5	0.000
2	78243	4.50	2673	0.	1439	4431	319	319	0.00	312.7	0.000
2	78250	2.09	1998	42	838	3104	268	226	15.67	249.4	0.014
2	78257	3.24	2650	253	1220	4530	661	408	38.28	265.6	0.056
2	78264	2.30	2609	471	931	4440	901	430	52.28	247.0	0.106
2	78271	1.14	2113	775	498	3812	1200	425	64.58	228.9	0.203
2	78278	.85	1905	782	371	3398	1122	340	69.70	229.1	0.230
2	78285	.53	1922	1149	236	3732	1574	425	73.00	224.5	0.308
2	78292	.07	1590	1206	30	3250	1630	424	73.99	233.3	0.371

CHAPTER THREE.

SYSTEM OVERVIEW

FLOW OF INFORMATION

The DSSAT v3 crop simulation models consist of three modules: model driver, input module and crop simulation module. Figure 1 presents a schematic overview of these modules. The main difference with the DSSAT v2.1 models is that the input and sensitivity analysis section of each model is now separated from its model simulation section. In DSSAT v3, one input and sensitivity module is used by all crop simulation models. When a user starts a DSSAT v3 model,

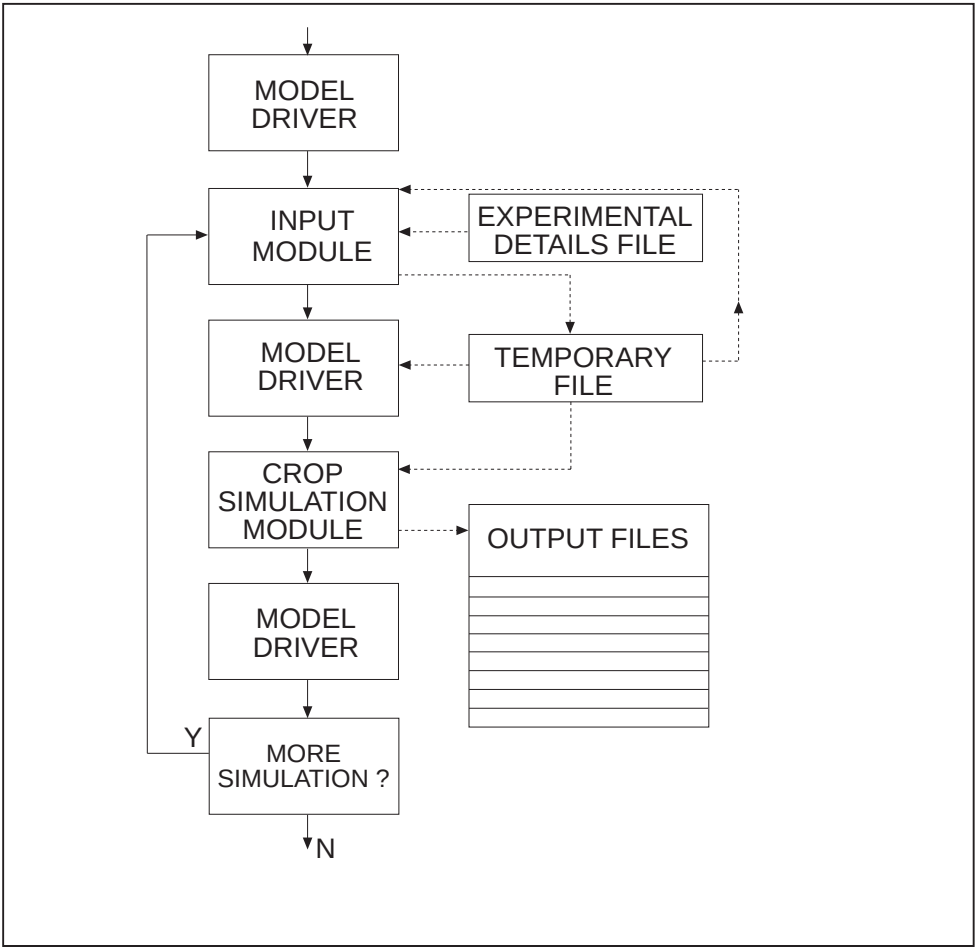


FIGURE 1. FLOW OF INFORMATION FOR THE CURRENT DSSAT v3 CROP SIMULATION MODELS.

\PATH\MDRIV940.EXE MINPT940.EXE CRGRO940.EXE

where PATH is the path for all EXE files (e.g. C:\DSSAT3);

MDRIV940.EXE is the name of the model driver;

MINPT940.EXE is the name of the input module; and

CRGRO940.EXE is the name of the crop simulation module.

Current crop simulation modules available include :

- GECER940.EXE - Generic CERES module for barley, maize, millet, sorghum, and wheat
- RICER940.EXE - CERES -Rice module for rice
- CRGRO940.EXE - Generic CROPGRO module for dry bean, peanut and soybean,
- CSSIM940.EXE - CROPSIM-Cassava module for cassava.

Additional options can be included on the command line:

\PATH\MDRIV940.EXE MINPT940.EXE CRGRO940.EXE TYPEIO RNMODE

where TYPEIO is a one-character variable, used as a file type for transfer of information between the input module and crop simulation module. Options include :

- I - A single treatment input file using FILEX format with no headers, blank lines or comment lines. TYPEIO = "I" is used by the GECER940.EXE, RICER940.EXE, and CRGRO940.EXE crop simulation modules.
- X - FILEX single treatment format with headers and blank lines. TYPEIO = "X" is used by the CSSIM940.EXE crop simulation module.

RNMODE is a one-character variable, used to define the execution or operational mode of the model. Options include :

- I - Interactive simulation, allowing for sensitivity analysis screen selections;
- A - Run all treatments defined for one particular experiment;
- G - Run in the genetic coefficient estimator mode, used with GenCalc only (see Volume 3-4, Hunt et al. 1994, of this book);
- N - Run in the seasonal analysis mode, used with the seasonal analysis program only (see Volume 3-1, Thornton et al. 1994a, of this book);
- Q - Run in the sequence analysis mode, used with the sequence analysis program only (see Volume 3-2, Thornton et al. 1994b, of this book);
- S - Run in the spatial analysis mode with Geographic Information Systems (GIS) only;
- F - Run in the farming systems analysis mode.

General users should not be concerned about these options, as they are controlled by individual driver programs.

For all RNMODE options, except "I," the experiment and treatment number can also be specified :

\PATH\MDRIV940.EXE MINPT940.EXE CRGRO940.EXE TYPEIO RNMODE EXPARG TRNARG

where EXPARG is the experiment number and TRNARG is the treatment number. Both EXPARG and TRNARG are integers.

The model driver program described here is normally used only for interactive simulations. Other components within DSSAT v3, such as the genetic coefficient calculator and seasonal analysis, sequence analysis and GIS programs, use their own driver programs to interface both with the model input module and crop simulation modules.

MODEL INPUT MODULE

The current DSSAT v3 input module was designed to handle both the reading of FILEX and error checking, as well as to make available options by which the user can modify specific inputs in the Sensitivity Analysis section. An example of this option will be presented later in this chapter. The function of the model input module is to read the experiment details file (FILEX), extract the required information to run one treatment, and to create a temporary input file to be read by the crop simulation module. This allows for the addition of other crop simulation models to the system, since only a temporary output file needs to be created in the prescribed format for use by the DSSAT v3 crop simulation models.

Without the model driver program, the following syntax is required to run the input module :

\PATH\MINPT940.EXE CRGRO940.EXE FILEIO TYPEIO RNMODE EXPARG TRNARG

where CRGRO940.EXE is the crop simulation module, with options as specified earlier; FILEIO is the name of the temporary input file used to transfer information between the input module and the crop simulation module – this name is usually controlled by the driver program which runs the entire system.

CROP SIMULATION MODULE

When the crop simulation module is executed, it reads the temporary input file, IBSNAT30.INP. This single treatment input file was created by the input module and

runs a single season simulation. The syntax to run a crop simulation module, without the model driver program, is the following :

```
\PATH\CRGRO940.EXE FILEIO TYPEIO RNMODE REPARG
```

The options specified on the command line are the same as those discussed for the input module, except for REPARG, which is the run number of the current simulation. It is critical that the correct file type be specified for the temporary file, since it contains the reduced input information for the crop model.

Normally, FILEIO will be "IBSNAT30.INP" and TYPEIO will be "I." TYPEIO can be set to "X" to create a single treatment version of FILEX, but only the CSSIM940.EXE crop simulation module will work with this option. The system's flexibility is such that when a new crop simulation module is added, only the input module needs to be modified to specify the input file type of the new crop simulation module and a subroutine added to write the new format.

CROP MODEL EXECUTION

In the above section, "Component Structure," of this Chapter, detailed information for the various command line arguments is included. In general, however, model users can ignore these individual options, since they are handled internally by the DSSAT v3 Shell, batch programs, or driver programs. Under the SETUP menu in the DSSAT v3 Shell (see Volume 1-3, Hunt et al. 1994, of this book), the user defines each individual module; that is, the crop model driver program (MDDRIV940.EXE), the crop model inputs module (MINPT940.EXE) and one of the crop simulation modules (e.g., GECER940.EXE, RICER940.EXE, CRGRO940.EXE or CSSIM940.EXE). In addition the user defines the file type of the intermediate file, which is set to "I" by default. The remainder of the controls are then handled by the DSSAT v3 Shell.

If a user wants to run each module individually, all command line arguments need to be used correctly and input files need to be available, as some of the individual modules do not handle error checking.

HARDWARE AND SOFTWARE

The DSSAT v3 crop simulation models were developed on personal computers, using Microsoft DOS™ Versions 5 and 6, and the Microsoft Fortran Compiler™ Version 5.1. The modules are coded in Fortran 77 to remain compatible with other platforms. The crop models have also been successfully implemented on VAX and SUN computers.

The crop models perform best on computers with 80386 or 80486 processor and math-coprocessors. Minimum memory requirements are 512 KByte of Random Access Memory. Harddisk requirements are at least 1 MByte for all executable and data files.

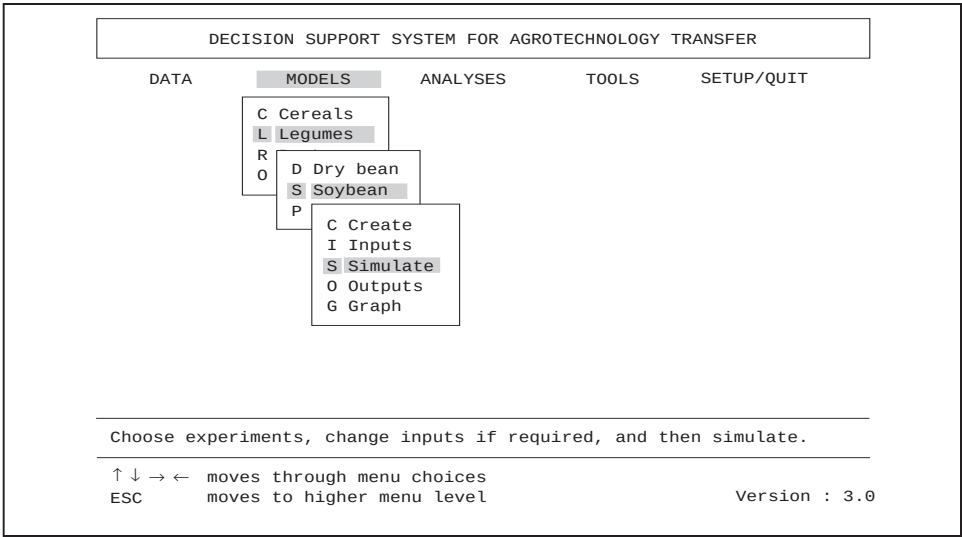
CHAPTER FOUR.

CREATING INPUT FILES

Under the DSSAT v3 Shell main menu item, MODELS (see Volume 1-3, Hunt et al. 1994, of this book), there is a menu of crop models available, separated into grain cereals, grain legumes, root crops, and other crops (see Screen 1). A menu belonging to each group contains a listing of various crops or species for the group selected (see Screen 1 for those crops found under “Legumes”). Although in the DSSAT v3 system all three grain legume crops (dry bean, peanut, and soybean) are simulated with the same model (CROPGRO), users have the option to change the selected crop model through the SETUP menu in the DSSAT v3 Shell and replace it with their own model. Instructions for modifying the SETUP options are presented in Volume 1-3 (Hunt et al. 1994) of this book. If the soybean model is selected, for example, a menu appears (Screen 1), showing a list of available options in the logical sequence a user needs to follow in order to simulate a particular experiment.

Five options are available under each crop model selection :

- 1. Creating a model input file.
- 2. Listing and managing crop model input files.
- 3. Running the crop model.
- 4. Listing and managing crop model output files.
- 5. Graphing simulated results and experimental data.



SCREEN 1.

TABLE 4. CROP MODEL INPUT FILE. (FILEX = "UFGA7801.SBX")

EXP.DETAILS: UFGA7801SB BRAGG, IRRIGATED & NON-IRRIGATED

*TREATMENTS

-----FACTOR LEVELS-----

@N	R	O	C	TNAME.....	CU	FL	SA	IC	MP	MI	MF	MR	MC	MT	ME	MH	SM
01	1	1	0	IRRIGATED	1	1	0	1	1	1	0	1	0	0	0	0	1
02	1	1	0	NON - IRRIGATED	1	1	0	1	1	0	0	1	0	0	0	0	1

*CULTIVARS

@C	CR	INGENO	CNAME
1	SB	IB0001	BRAGG

*FIELDS

@L	ID_FIELD	WSTA....	FLSA	FLOB	FLDT	FLDD	FLDS	FLST	SLTX	SLDP	ID_SOIL
1	UFGA0001	UFGA7801	-99	0	DR000	0	0	00000	-99	180	IBSB910015

*INITIAL CONDITIONS

@C	PCR	ICDAT	ICRT	ICND	ICRN	ICRE
1	SB	78166	100	-99	1.00	1.00
@C	ICBL	SH20	SNH4	SN03		
1	5	0.086	0.6	1.5		
1	15	0.086	0.6	1.5		
1	30	0.086	0.6	1.5		
1	45	0.086	0.6	1.5		
1	60	0.086	0.6	1.5		
1	90	0.076	0.6	0.6		
1	120	0.076	0.6	0.5		
1	150	0.130	0.6	0.5		
1	180	0.258	0.6	0.5		

*PLANTING DETAILS

@P	PDATE	EDATE	PPOP	PPOE	PLME	PLDS	PLRS	PLRD	PLDP	PLWT	PAGE	PENV	PLPH
1	78166	-99	29.9	29.9	S	R	91	0	4.0	-99	-99	-99.0	-99.0

*IRRIGATION AND WATER MANAGEMENT

@I	EFIR	IDEP	ITHR	IEPT	IOFF	IAME	IAMT
1	0.75	-99	-99	-99	-99	-99	-99
@I	IDATE	IROP	IRVAL				
1	78181	IR001	13				
1	78230	IR001	13				
1	78235	IR001	13				
1	78237	IR001	13				
1	78240	IR001	11				
1	78242	IR001	11				
1	78244	IR001	11				
1	78246	IR001	11				
1	78250	IR001	11				
1	78253	IR001	11				
1	78256	IR001	8				
1	78259	IR001	8				

@R	RDATE	RCOD	RAMT	RESN	RESP	RESK	RINP	RDEP
1	78166	RE001	1000	0.8	-9	-9		15

GENERAL INFORMATION												
@N GENERAL	NYERS	NREPS	START	YRDAY	RSEED	SNAME.....						
1 GE	1	1	S	78166	2150	BRAGG, IRRIGATED & NON-IR						
@N OPTIONS	WATER	NITRO	SYMBI	PHOSP	POTAS	DISES						
1 OP	Y	Y	Y	N	N	N						
@N METHODS	WTHFR	INCON	LIGHT	EVAPO	INFIL	PHOTO						
1 ME	M	M	E	R	S	C						
@N MANAGEMENT	PLANT	IRRIG	FERTI	RESID	HARVS							
1 MA	R	R	R	R	M							
@N OUTPUTS	FNAME	OVVIEW	SUMRY	FROPT	GROTH	CARBN	WATER	NITRO	MINER	DISES	LONG	
1 OU	N	Y	Y	3	Y	Y	Y	Y	N	N		

@N PLANTING	PFIRST	PLAST	PH20L	PH20U	PH20D	PSTMX	PSTMN
1 PL	155	200	40	100	30	40	10
@N IRRIGATION	IMDEP	ITHRL	ITHRU	IROFF	IMETH	IRAMT	IREFF
1 IR	30	50	100	GS000	IR001	10	0.75
@N NITROGEN	NMDEP	NMTHR	NAMNT	NCODE	NAOFF		
1 NI	30	50	25	FE001	GS000		
@N RESIDUES	RIPCN	RTIME	RIDEP				
1 RE	100	1	20				
@N HARVEST	HFIRST	HLAST	HPCNP	HPCNR			
1 HA	0	365	100	0			

*CULTIVARS

This defines the crop (CR) and cultivar (INGENO) which will be simulated.

*FIELDS

This defines the weather station (WSTA) and soil profile (ID_SOIL) which will be used as inputs.

*INITIAL CONDITIONS

This defines the initial soil water (SH_2O) and nitrogen conditions at the start of simulation ($\text{SNH}_4 + \text{SNO}_3$).

*PLANTING DETAILS

This defines the planting date (PDATE), plant density (PPOP), row spacing (PLRS) and planting depth (PLDP) at planting.

*IRRIGATION AND WATER MANAGEMENT

This defines the dates (IDATE) and amounts (IRVAL) of irrigation applications.

*FERTILIZERS

This defines the dates (FDATE), amount (FAMN) and types (FMDC) of fertilizer applications.

*ENVIRONMENT MODIFICATIONS

This defines environmental modifications related to weather conditions.

*HARVEST DETAILS

This defines final harvest date ((HDATE) and other harvest parameters.

*RESIDUES AND OTHER ORGANIC MATERIALS

This defines initial residue from the previous crop present at the start of simulation.

The importance of the above sections depends on the treatment factor levels selected in the *TREATMENT section.

*SIMULATION CONTROLS

This section is critical, since it defines the various options available for simulation, such as water balance and nitrogen balance simulation, crop management options, and defines the output files and output frequency.

Volume 2-1 (Jones et al. 1994) of this book presents additional details about the specifics of each input section and the headers and header abbreviations for FILEX and various examples.

The models require an experiment list file (FILEL) to display the various experiments available for simulation (Table 5). The XCreate program updates the experiment list after each new FILEX is created by a user. In addition, DSSAT v3 has an experiment File Manager utility that is accessed by selecting the “I Inputs” option under the MODELS menu of the DSSAT v3 Shell (Screen 1). The File Manager utility allows the user to either include or exclude a particular experiment from the experiment list file, and also includes options to edit a particular experiment data file and search and sort. For a description of this utility, see Volume 1-3 (Hunt et al. 1994) of this book.

TABLE 5. EXPERIMENT LIST FILE. (FILEL = "EXP.LST")

*EXPERIMENT LIST

```
@# FILENAME EXT ENAME
1 IUCA7901 SBX WAYNE, IRRIGATED & NON-IRRIGATED
2 UFGA7801 SBX BRAGG, IRRIGATED & NON-IRRIGATED
3 UFGA7802 SBX BRAGG, IRR*INSECT DAMAGE
4 UFGA7901 SBX IRRIGATION 3I
5 UFGA8101 SBX COBB, IRRIGATED, VEG. & REPROD. STRESS
6 UFQU7901 SBX BRAGG, WELL IRRIGATED
7 UFQU7902 SBX BRAGG, DEFOLIATION STUDY
```


What is displayed on Screen 4 is actually a listing of FILEL (see Table 5). Any one of these experiments can be selected for simulation. Each item in the list may represent an actual experiment or a hypothetical one created to predict how a crop would perform under specified conditions. For the example shown, Experiment "2" was selected, which was a soybean experiment, conducted in 1978 at the University of Florida in Gainesville

When this experiment is selected, Screen 5 (shown below) is presented.

BRAGG, IRRIGATED & NON-IRRIGATED		INST. ID	SITE ID	YEAR	EXPT. NO	TRT. NO
-----		----	----	----	----	----
1.	IRRIGATED	UF	GA	1978	01	1
2.	NON - IRRIGATED	UF	GA	1978	01	2
3.	RUN ALL TREATMENTS	UF	GA	1978	01	
TREATMENT SELECTED ==>						1
NEW SELECTION ? ==>						1

Screen 5 displays the treatments of Experiment “2” selected in Screen 4. For this experiment, there are two treatments, irrigated (Option 1) and non-irrigated (Option 2). In addition, in Screen 5, a user can choose to have the model simulate all treatments of the particular experiment (Option 3). For this example experiment, Option 1 was selected.

Screen 7 (above) displays an overview of the inputs and simulation data for the experiment selected in Screen 4. These data include crop, cultivar and maturity group information; start of simulation and planting dates; row and plant spacing; weather site and year; general soil profile information and initial conditions at the start of simulation; water balance simulation option and irrigation management; nitrogen balance simulation, nitrogen fertilizer management and organic residue; environmental or weather variable modifications; and a summary of simulation and management options.

which is displayed during the actual model simulation. All the variables shown in this screen are predicted variables.

SIMULATED CROP AND SOIL STATUS AT MAIN DEVELOPMENT STAGES													
RUN NO.		Example											
DATE	CROP AGE	GROWTH STAGE	BIOMASS kg/ha	LAI	LEAF NUM.	ET mm	RAIN mm	IRRIG mm	SWATER mm	CROP kg/ha	N %	STRESS H2O	N
15 JUN	0	START SIM	0	.00	.0	0	0	0	158	0	.0	.00	.00
15 JUN	0	SOWING	0	.00	.0	0	0	0	158	0	.0	.00	.00
21 JUN	6	EMERGENCE	21	.03	.1	3	2	0	157	1	5.1	.00	.06
21 JUN	6	END JUVEN.	21	.03	.1	3	2	0	157	1	5.1	.00	.06
28 JUN	13	UNIFOLIATE	60	.11	1.2	11	10	0	157	3	5.1	.00	.26
2 JUL	17	FLOWER IND	116	.20	2.1	20	10	13	157	5	4.3	.03	.32
31 JUL	46	FIRST FLWR	1854	3.25	8.8	128	274	13	186	61	3.3	.00	.27
22 AUG	68	FIRST POD	4340	5.22	13.9	230	518	26	149	156	3.6	.00	.01
22 AUG	68	FIRST POD	4340	5.22	13.9	230	518	26	149	156	3.6	.00	.01
29 AUG	75	END MSNODE	5304	5.19	15.4	268	518	63	139	185	3.5	.00	.00
29 AUG	75	END LEAF	5304	5.19	15.4	268	518	63	139	185	3.5	.00	.00
1 SEP	78	FIRST SEEND	5710	5.13	15.4	285	518	85	138	196	3.4	.00	.00
1 OCT	108	END POD	7469	3.36	15.4	401	534	165	98	245	3.3	.13	.01
11 OCT	118	PHYS. MAT	7747	2.89	15.4	431	534	180	78	263	3.4	.32	.07
23 OCT	130	HARV. MAT	6107	.19	15.4	448	534	190	69	224	3.7	.47	.10
23 OCT	130	HARVEST	6107	.19	15.4	448	534	190	69	224	3.7	.47	.10

SCREEN 9.

Each model is initialized at the start of simulation date, as specified in the input file. All models operate at daily time steps; thus, growth, development and other variables are incremented daily. Each crop model predicts the critical growth stages for that particular crop as shown in Screen 9 (above) for soybean. At each stage, total biomass, leaf area index (LAI), total number of leaves on the main stem and total nitrogen (CROP) and nitrogen concentration (N) are shown. These variables relate mainly to the carbon and nitrogen balance of the models. In addition, some soil and plant water variables are shown, such as total evapotranspiration (ET), total rainfall received and irrigation applied, and plant extractable soil water. The last two columns in Screen 9 show plant water and nitrogen stress averages calculated from the time of the previous stage until the current stage.

When the last stage, e.g., “HARVEST” for this example, appears, the simulation has ended. The actual time it will take from the start of simulation, “START SIM,” until final harvest, can vary from a few seconds to a few minutes, depending on computer hardware and the crop management options selected.

VARIABLE -----	PREDICTED -----	MEASURED -----
ANTHESIS DATE (dap)	46	45
FIRST PEG / POD (dap)	68	67
FIRST SEED (dap)	78	67
PHYSIOLOGICAL MATURITY (dap)	118	116
POD YIELD (kg/ha)	3941	4009.
SEED YIELD (Kg/ha)	2932	3041.
SHELLING PERCENTAGE (%)	74.41	75.85
WEIGHT PER SEED (g)	.133	.1440
SEED NUMBER (SEED/m2)	2202	2223.
SEEDS/POD	2.05	1.96
MAXIMUM LAI (m2/m2)	5.25	4.67
BIOMASS (kg/ha) AT ANTHESIS	1854	-99
BIOMASS N (kg N/ha) AT ANTHESIS	61	-99
BIOMASS (kg/ha) AT HARVEST MAT.	6107	6068.
STALK (kg/ha) AT HARVEST MAT.	2087	1958.
HARVEST INDEX (kg/ha)	.480	.501
FINAL LEAF NUMBER (MAIN STEM)	15.41	-99
SEED N (kg N/ha)	187	-99
BIOMASS N (kg N/ha)	224	-99
STALK N (kg N/ha)	20	-99
SEED N (%)	6.37	-99
Please press < ENTER> key to continue		

SCREEN 10.

After the seasonal results are presented in Screen 9, model predicted data can be compared with experimental data for the main development stages, yield and yield components, and some of the nitrogen variables (Screen 10, above). When no experiment data are available for a particular stage, a “-99” is displayed for that item.

Screen 11 (above), the final screen in this series, displays a summary of environmental variables derived during the main developmental stages, which include the vegetative growth phase until flowering, the vegetative and reproductive development growth phase from flowering until the start of seed growth, and the reproductive growth phase from beginning seed growth until physiological maturity. To simulate another treatment or another experiment, a user needs to enter a 'Y' at the prompt. An 'N' entry ends the crop model simulation and the user can then print out or graph the simulated results. For a description of the graphing and printing options, see Chapter 7, "Displaying Results."

Example listings of the OVERVIEW.OUT file is shown in Table 6A for CERES-Maize and Table 6B for CROPGRO-Soybean.

*SIMULATED CROP AND SOIL STATUS AT MAIN DEVELOPMENT STAGES

RUN NO. 1 Example CERES-Maize

	DATE	CROP	GROWTH	BIOMASS	LAI	LEAF	ET	RAIN	IRRIG	SWATER	CROP	N	STRESS	
		AGE	STAGE	kg/ha		NUM.	mm	mm	mm	mm	kg/ha	%	H2O	N
	25	FEB	0	Start Sim	0	.00	.0	0	0	0	152	0	.0	.00 .00
	26	FEB	0	Sowing	0	.00	.0	1	0	0	151	0	.0	.00 .00
	27	FEB	1	Germinate	0	.00	.0	1	0	0	151	0	.0	.00 .00
	7	MAR	9	Emergence	29	.00	1.9	11	58	13	205	1	4.4	.00 .00
	22	MAR	24	End Juveni	141	.30	7.5	23	60	23	161	5	3.9	.02 .00
	27	MAR	29	Floral Ini	275	.52	9.0	35	103	23	179	11	3.9	.00 .01
	12	MAY	75	75% Silkin	9251	4.64	23.7	214	361	142	165	194	2.1	.00 .03
	22	MAY	85	Beg Gr Fil	11940	4.36	23.7	267	363	201	166	193	1.6	.00 .02
	3	JUL	127	Maturity	23149	2.02	23.7	456	661	264	156	245	1.1	.00 .05
	3	JUL	127	Harvest	23149	2.02	23.7	456	661	264	156	245	1.1	.00 .05

*MAIN GROWTH AND DEVELOPMENT VARIABLES

@	VARIABLE	PREDICTED	MEASURED
	-----	-----	-----
	FLOWERING DATE (dap)	75	75
	PHYSIOL. MATURITY (dap)	127	128
	GRAIN YIELD (kg/ha)	13769	14060
	WT. PER GRAIN (g)	.2971	0.309
	GRAIN NUMBER (GRAIN/m2)	3916	3847.
	GRAINS/EAR	543.90	496.
	MAXIMUM LAI (m2/m2)	4.71	-99
	BIOMASS (kg/ha) AT ANTHESIS	9251	-99
	BIOMASS N (kg N/ha) AT ANTHESIS	194	-99
	BIOMASS (kg/ha) AT HARVEST MAT.	23149	22001
	STALK (kg/ha) AT HARVEST MAT.	11515	10120
	HARVEST INDEX (kg/kg)	.595	-99
	FINAL LEAF NUMBER	23.75	-99
	GRAIN N (kg N/ha)	190	192.9
	BIOMASS N (kg N/ha)	245	267.7
	STALK N (kg N/ha)	55	74.8
	SEED N (%)	1.64	1.60

*SIMULATION OVERVIEW FILE

*SUMMARY OF SOIL AND GENETIC INPUT PARAMETERS

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*SIMULATED CROP AND SOIL STATUS AT MAIN DEVELOPMENT STAGES

RUN NO. 1 Example CROPGRO - Soybean

DATE	CROP AGE	GROWTH STAGE	BIOMASS kg/ha	LAI	LEAF NUM.	ET mm	RAIN mm	IRRIG mm	SWATER mm	CROP kg/ha	N %	STRESS H2O	N
15 JUN	0	START SIM	0	.00	.0	0	0	0	158	0	.0	.00	.00
15 JUN	0	SOWING	0	.00	.0	0	0	0	158	0	.0	.00	.00
21 JUN	6	EMERGENCE	21	.03	.1	3	2	0	157	1	5.1	.00	.06
21 JUN	6	END JUVEN.	21	.03	.1	3	2	0	157	1	5.1	.00	.06
28 JUN	13	UNIFOLIATE	60	.11	1.2	11	10	0	157	3	5.1	.00	.26
2 JUL	17	FLOWER IND	116	.20	2.1	20	10	13	157	5	4.3	.03	.32
31 JUL	46	FIRST FLWR	1854	3.25	8.8	128	274	13	186	61	3.3	.00	.27
22 AUG	68	FIRST POD	4340	5.22	13.9	230	518	26	149	156	3.6	.00	.01
22 AUG	68	FIRST POD	4340	5.22	13.9	230	518	26	149	156	3.6	.00	.01
29 AUG	75	END MSNODE	5304	5.19	15.4	268	518	63	139	185	3.5	.00	.00
29 AUG	75	END LEAF	5304	5.19	15.4	268	518	63	139	185	3.5	.00	.00
1 SEP	78	FIRST SEED	5710	5.13	15.4	285	518	85	138	196	3.4	.00	.00
1 OCT	108	END POD	7469	3.36	15.4	401	534	165	98	245	3.3	.13	.01
11 OCT	118	PHYS. MAT	7747	2.89	15.4	431	534	180	78	263	3.4	.32	.07
23 OCT	130	HARV. MAT	6107	.19	15.4	448	534	190	69	224	3.7	.47	.10
23 OCT	130	HARVEST	6107	.19	15.4	448	534	190	69	224	3.7	.47	.10

*MAIN GROWTH AND DEVELOPMENT VARIABLES

@	VARIABLE	PREDICTED	MEASURED
	-----	-----	-----
	ANTHESIS DATE (dap)	46	45
	FIRST PEG / POD (dap)	68	67
	FIRST SEED (dap)	78	67
	PHYSIOLOGICAL MATURITY (dap)	118	116
	POD YIELD (kg/ha)	3941	4009.
	SEED YIELD (kg/ha)	2932	3041.
	SHELLING PERCENTAGE (%)	74.41	75.85
	WEIGHT PER SEED (g)	.133	.1440
	SEED NUMBER (SEED/m2)	2202	2223.
	SEEDS/POD	2.05	1.96
	MAXIMUM LAI (m2/m2)	5.25	4.67
	BIOMASS (kg/ha) AT ANTHESIS	1854	-99
	BIOMASS N (kg N/ha) AT ANTHESIS	61	-99
	BIOMASS (kg/ha) AT HARVEST MAT.	6107	6068.
	STALK (kg/ha) AT HARVEST MAT.	2087	1958.
	HARVEST INDEX (kg/kg)	.480	.501
	FINAL LEAF NUMBER (MAIN STEM)	15.41	-99
	SEED N (kg N/ha)	187	-99
	BIOMASS N (kg N/ha)	224	-99
	STALK N (kg N/ha)	20	-99
	SEED N (%)	6.37	-99

*ENVIRONMENTAL AND STRESS FACTORS

		-ENVIRONMENT-					-STRESS-			
--DEVELOPMENT PHASE--		TIME	-----WEATHER-----			---WATER--		-NITROGEN-		
		DURA	TEMP	TEMP	SOLAR	PHOTOP	PHOTO	GROWTH	PHOTO	GROWTH
		TION	MAX	MIN	RAD	[day]	SYNTH		SYNTH	
		days	oC	oC	MJ/m2	hr				

Emergence	-First Flower	40	33.04	22.20	19.34	13.74	.000	.004	.000	.273
First Flower	-First Seed	32	33.33	21.71	19.55	13.03	.000	.000	.000	.006
First Seed	- Phys. Mat.	40	31.95	19.39	16.82	11.98	.099	.179	.098	.022
Emergence	- Phys. Mat.	112	32.73	21.06	18.50	12.91	.035	.066	.035	.107

```
(0.0 = Minimum Stress
1.0 = Maximum Stress)
```

SOYBEAN YIELD : 2932 kg/ha [DRY WEIGHT]

variables as simulated by the crop models. Although these files can be edited, they are normally wider than 80 characters and fairly long, depending upon the number of simulations made by the user. The first 13 variables of each of the listed output files are identical for all crop models, with the first two variables being year-day of year and days after planting. Additional variables can be added as a function of each individual model. For more detailed information, see Volume 2-1 (Jones et al., 1994) of this book.

One of the features of the General File Manager allows the installation of a user's editor. By selecting the Edit option (key < F8>) and positioning the highlight bar over the file name, this output file can be edited. An option for a printout of this output file can also be selected from the editor. The General File Manager includes other options, which are discussed in Volume 1-3 (Hunt et al. 1994) of this book.

The crop models automatically overwrite existing output files. Thus, when a new crop model run is initiated, the old output files are erased and new output files are opened. To keep and save output files, a user can rename the generically-named model output files, or select an option under the Sensitivity Analysis section to store the output files, using a naming convention with Institute and Site code IDs similar to those used for the experiment input file.

GRAPHIC DISPLAY

DSSAT v3 contains a Graphics option, shown in Screen 1. When this option is selected, the graphics display program, Wingraf is run. See Part 3 of this Volume (Volume 2-3, Chan et al. 1994) for a description of this program. Screen 13 (on the following page) displays the first Wingraf screen.

Wingraf allows the user to display the simulated data as a function of day of year or planting date. In addition, field-measured data are included in the graph, when available.

A user can graphically display growth and development variables: (GROWTH.OUT), soil and plant water and weather variables (WATER.OUT), soil and plant nitrogen variables (NITROGEN.OUT), pest and disease variables (PEST.OUT) and carbon balance and photosynthesis variables (CARBON.OUT). By selecting the menu option “User-Selected Variables” displayed in Screen 13, a user can also design a new list of variables by combining variables from previously listed options (see Screens 14 and 15).

For our example, the “Growth” option was selected in Screen 13, which produces a screen with a list of available variables for graphing (see Screen 14).

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[■] = Select Graph Options Exit

[■] ————— **GROWTH** —————

Variables ☐ Leaf number per stem ☐ Growth stage ☐ Leaf area index ☒ Leaf dry weight (kg/ha) ☒ Stem dry weight (kg/ha) ☒ Grain dry weight (kg/ha) ☒ Root dry weight (kg/ha) ☒ Crop dry weight (kg/ha) ☐ Grain number (no/m ²) ☐ Grain dry weight (mg/grain) ☐ Harvest index (grain/top) ☐ Pod dry weight (kg/ha) ☐ Pod number (no/m ²) ☐ Photo water stress factor (0-1) ☐ Growth water stress factor (0-1)	Run Numbers ☒ Example
--	---

SCREEN 14.

In Screen 14 (above), a user can choose to have displayed up to 6 variable-run combinations. Press the NEXT button on this screen to present another screen (Screen 15, below) displaying additional variables available for graphing.

[■] = Select Graph Options Exit

[■] GROWTH

Variables	Run Numbers
Nitrogen stress factor (0-1)	
Leaf N concentration (%)	
Shelling % (seed wt/pod st*100)	
Pod harvest index (pod/top)	
Detached pod dry weight (kg/ha)	
Total pod dry weight (kg/ha)	
Specific leaf area Cm ² /g)	
Canopy height (m)	
Canopy breadth (m;for 1 row)	
Nodule dry weight (kg/ha)	
Root depth (m)	
Root density, 0-5 cm (cm/cm ³)	
Root density, 5-15 cm (cm/cm ³)	
Root density, 15-30 cm (cm/cm ³)	
Root density, 30-45 cm (cm/cm ³)	

Previous Next X Variable Graph Reset Option

F1 Help Esc Escape X Var.: Time Simulation: Default

SCREEN 15.

The **OPTION** button in Screens 14 and 15 is **only** available once a graph has been plotted. Then it can be used to make necessary modifications to the current graph, such as changing the x, y coordinates, modifying the multiplier for each plot, changing the min/max values, turning the graph grid line “On” or “Off” and printing the graph to a hard copy.

Figure 1 is a line graph showing the growth of a crop over time from June 5 to November 1. The Y-axis represents weight in kg/ha, ranging from 0.0k to 10.0k. The X-axis shows dates: Jun 5, Jul 12, Aug 18, Sep 25, and Nov 1. Five data series are plotted: Leaf Weight (dotted line with '+' markers), Stem Weight (dashed line with triangle markers), Grain Weight (dashed line with asterisk markers), Root Weight (dash-dot line with dot markers), and Biomass (solid line with 'x' markers). Biomass increases steadily to a peak of about 8.0k kg/ha in late September before declining. Leaf weight peaks in late August at about 3.5k kg/ha. Stem weight peaks in late September at about 3.5k kg/ha. Grain weight peaks in late September at about 2.5k kg/ha. Root weight peaks in late August at about 1.5k kg/ha.

Date	Leaf WT. (kg/ha)	Stem WT. (kg/ha)	Grain WT. (kg/ha)	Root WT. (kg/ha)	Biomass (kg/ha)
Jun 5	0.0	0.0	0.0	0.0	0.0
Jul 12	0.5	0.5	0.2	0.8	1.5
Aug 18	3.5	2.0	1.0	1.5	5.0
Sep 25	2.0	3.5	2.5	1.0	7.5
Nov 1	1.0	2.0	3.0	0.5	6.5

Screen 16 shows an example graph with model predicted data depicted as lines and field-measured data as symbols. A detailed description of the Wingraf program can be found in Part 3 of this Volume (Volume 2-3, Chan et al. 1994).

Screen 18 shows the various categories of variables which can be modified.

The “Simulation Timing and Control” menu (Screen 19 on the next page) allows the user to define when a simulation begins. In all cases, the start of simulation date and year (Options 1 and 2) has to be earlier than the planting date, since all model variables are initiated at the start of simulation date. During the period between start of simulation and the planting date only the soil water and nitrogen balances are simulated.

Option 4, “Number of Years to be Simulated,” allows the user to specify how many years will be simulated. This is normally set to “1.” If, in the example screen shown, the “Number of Years” was set to “2,” the model would conduct two simulations, one for 1978, and one for 1979. The user needs to be sure that weather data are available for the years for which the simulations are to be run.

CROP

The “Crop Selection and Modification” menu shown in Screen 21 (below) can currently be used only with the grain legume models.

```

CROP SELECTIONS AND MODIFICATION
=====

0. Return to Previous Menu

1. Crop Selection .....[ SOYBEAN
2. Crop Parameter File .....[ SBGR0930.SPE

SELECTION ? [ Default = 0 ] --->

```

SCREEN 21.

When Option 1, "Crop Selection," is selected is Screen 21, the system checks which crop species files are present and then displays Screen 22 (below).

When Option 2, “Crop Parameter File,” is selected in Screen 21, the user can choose a different crop species or parameter file as input. The default crop

```
IBSNAT 3.0 CROPS
=====
1)      DRY BEANS
2)      PEANUT
3)      SOYBEAN

SELECT CROP (#) ==> 1
```

SCREEN 22.

WEATHER

The “Weather Data Selection and Modification” menu allows the user to select and modify input variables related to the weather conditions (Screen 26, below).

```

                                WEATHER DATA SELECTION AND MODIFICATION
                                =====
0. Return to Previous Menu
1. Recorded/Simulated Data .....[ OBSERVED DATA
2. Weather Data Selection .....[ UFGA7801.WTH
3. Weather Data Path .....[ C:\DSSAT3\WEATHER\
4. Enter Weather File Name Interactive.[ UFGA7801.WTH
5. Weather Data Modification .....[ N

SELECTION ? [ Default = 0 ] ---> 1
```

SCREEN 26.

In Screen 26, Option 1, “Recorded/Simulated Data,” allows the user to define if either measured/observed weather data or generated weather data are to be used. In the case of generated data, the model generates these data internally through one of two weather generators that are part of the models, or by reading data from files which contain generated weather data (see Screen 27, on following page).

When Option 2, “Weather Data Selection,” is selected, Screen 28 (on following page) is presented.

Option 3, “Weather Data Path,” allows the user to define an alternate path where weather data files are located.

Option 4, “Enter Weather File Name Interactive,” allows the user to enter an alternate file name. A user must be certain that this file exists; otherwise the model will not be able to simulate the selected management conditions. If a different weather year is selected, the system will modify all date-related inputs to the year selected.

Option 5, “Weather Data Modification,” allows the user to interactively modify the weather variables by either adding or subtracting a constant number, multiplying one or more weather variables by a constant number, or setting one or more variables as constant. If ‘Y’ is selected for this Option, Screen 29 (on following page) is presented.

```

WEATHER INPUT METHODS
=====
0. Return to Previous Menu
1. Field Observed Data ..... |
2. Externally Simulated Data ..... |
3. Internally Generated Data ..... |

CURRENT WEATHER INPUT CONDITIONS ==> OBSERVED DATA
SELECTION (#) ? [ Default = 0 ] --->

```

SCREEN 27.

WEATHER LOCATIONS	LAT.	LONG	ELEV	YEAR	DATA SET
1) CIAT, PALMIRA, COLOMBIA	3.500	-76.400	-99.	1986	CCPA8601.WTH
2) CIAT, PALMIRA, COLOMBIA	3.500	-76.400	-99.	1987	CCPA8701.WTH
3) SUPHEN_BURI, THAILAND	14.500	100.100	-99.	1985	DTSP8501.WTH
4) CNPAF, GOIANIA, BRAZIL	-16.300	-49.100	-99.	1987	EBG08701.WTH
5) ICTA, QUEZADA, GUATEMALA	14.300	-90.000	-99.	1989	IGQU8901.WTH
6) IIRRI, MUNOZ, PHILIPPINES	15.700	120.900	-99.	1985	IRMZ8501.WTH
7) IIRRI, MUNOZ, PHILIPPINES	15.700	120.900	50.	1986	IRMZ8601.WTH
8) IIRRI, PILA, PHILIPPINES	14.200	121.300	50.	1980	IPPI8001.WTH
9) IIRRI, PILA, PHILIPPINES	14.200	121.300	50.	1985	IPPI8501.WTH
10) IIRRI, PILA, PHILIPPINES	14.200	121.300	-99.	1986	IPPI8601.WTH
11) CASTANA, IOWA, USA	42.200	-93.700	-99.	1979	IUCH7901.WTH
12) ASHLAND, KANSAS, USA	39.000	-97.000	-99.	1981	KSAS8101.WTH
13) KAJONDI_FARM, BURUNDI	-3.300	30.000	10.	1986	UBKA8601.WTH
14) GAINESVILLE, FLORIDA, USA	29.600	-82.400	10.	1976	UFGA7601.WTH
15) GAINESVILLE, FLORIDA, USA	29.600	-82.400		1978	UFGA7801.WTH
More... PRESS ENTER KEY					
16) GAINESVILLE, FLORIDA, USA	29.600	-82.400	10.	1979	UFGA7901.WTH
17) GAINESVILLE, FLORIDA, USA	29.600	-82.400	10.	1980	UFGA8001.WTH
18) GAINESVILLE, FLORIDA, USA	29.600	-82.400	10.	1981	UFGA8101.WTH
19) GAINESVILLE, FLORIDA, USA	29.600	-82.400	10.	1982	UFGA8201.WTH
20) GAINESVILLE, FLORIDA, USA	29.600	-82.400	10.	1984	UFGA8401.WTH
21) GAINESVILLE, FLORIDA, USA	29.600	-82.400	10.	1985	UFGA8501.WTH
22) GAINESVILLE, FLORIDA, USA	29.600	-82.400	10.	1986	UFGA8601.WTH
23) QUINCY, FLORIDA, USA	30.600	-86.400	-99.	1979	UFQU7901.WTH
WEATHER DATA SELECTED ==> 15					
ALTERNATE SELECTION ? --->					

SCREEN 28.

SCREEN 29.

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Screen 30 allows the user to choose one of the modification options listed in order to revise or alter the weather variable selected in Screen 29 (on preceding page).

The “Soil Profile Selection and Modification” menu allows the user to modify input variables related to the soil profile characteristics (Screen 31, below).

```

SOIL PROFILE SELECTION AND MODIFICATION
=====

0. Return to Main Menu

1. Soil Profile Selection .....[ IBSB910015 - FSH
2. Soil Profile File .....[ SOIL.SOL
3. Soil Profile Path .....[ C:\DSSAT3\SOIL\
4. Soil Profile Layer Thickness .....|
5. Soil Profile Parameters .....|
6. Soil Surface Parameters .....|

SELECTION ? [ Default = 0 ] ---> 1

```

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In Screen 31, Option 1, “Soil Profile Selection,” allows the user to select an alternate soil profile as input. If this option is selected, Screen 32 (on following page) is presented. As can be seen in Screen 31, pedon number IBSB910015 “Millhopper Fine Sand” was selected from Screen 32. When an alternate soil profile is selected as input from that first presented in Screen 31, the user will be requested to redefine the initial soil conditions, because for many soils the initial conditions are soil profile specific (see Screen 34).

Option 2, “Soil Profile File” in Screen 31, allows the user to define an institute soil file as an alternate soil input file. For this example experiment, the institute is the University of Florida. Therefore the alternate soil file would be UF.SOL.

Option 3, “Soil Profile Path,” allows the user to define an alternate directory path for the soil file.

Option 4, “Soil Profile Layer Thickness,” allows the user to modify the thickness of each soil profile layer. If this option is selected, Screen 33 (on following page) is presented.

Option 5, “Soil Profile Parameters,” allows the user to modify the input values for the most important soil profile parameters. These include the drained upper limit, lower limit of plant extractable soil water, saturated water content, initial soil water content, bulk density, pH, soil organic carbon content, and rooting characteristics. If this option is selected, Screen 34 is presented.

Option 6, “Soil Surface Parameters,” allows the user to modify the input values for the most important soil surface characteristics. These include soil albedo, first stage evaporation limit, runoff curve number, drainage rate, nitrogen mineralization factor, and growth reduction or fertility factor, which is only implemented in the grain legume models. If this option is selected, Screen 35 is presented.

Screen 32 shows a listing of some of the soil profiles available. More information on how to modify the initial conditions is described in the next section, “Initial Conditions,” in this Chapter.

```

LAYER DEPTH MODIFICATION
=====

0)  RETURN TO THE MAIN MENU

1)      .00  -    5.00.....]      5.00  cm
2)      5.00  -   15.00.....]     10.00  cm
3)     15.00  -   30.00.....]     15.00  cm
4)     30.00  -   45.00.....]     15.00  cm
5)     45.00  -   60.00.....]     15.00  cm
6)     60.00  -   90.00.....]     30.00  cm
7)     90.00  -  120.00.....]     30.00  cm
8)    120.00  -  150.00.....]     30.00  cm
9)    150.00  -  180.00.....]     30.00  cm

SELECTION ? [ Default = 0 ] ==>

```

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```

=====
INITIAL CONDITIONS AT START OF SIMULATION
=====

0. Return to Previous Menu

1. Initial Soil Water Content .....0
2. Initial Soil N03 .....0
3. Initial Soil NH4 .....0
4. Growth Reduction Factor Due to Poor Soil Fertility ..] .840
5. Root Weight from Previous Crop .....] 100.00
6. Nodule Weight from Previous Crop .....] .00
7. Previous Crop .....] SB

SELECTION ? [ Default = 0 ] --->

```

In Screen 36, Options 1, 2 and 3, "Initial Soil Water Content," "Initial Soil NO₃" and "Initial Soil NH₄," respectively, allow the user to modify these variables for each layer. If Option 1 is selected, Screen 37 (on following page) is presented.

Option 4, "Growth Reduction Factor Due to Poor Soil Fertility," is used only in the grain legume models to adjust biomass growth for conditions which are currently not included in the crop process simulations.

Options 5, 6 and 7, "Root Weight from Previous Crop," "Nodule Weight from Previous Crop" and "Previous Crop," respectively, relate to crop residues remaining from previous crop and which are present at planting of the current crop. This information is needed when the soil nitrogen balance is simulated.

Screen 37 displays the variables which can be changed if Option 1, "Initial Soil Water Content" in Screen 36, is selected.

PLANTING

The “Planting Timing and Control” menu allows the user to define the conditions at planting (Screen 38, below).

```

PLANTING TIMING AND CONTROL
=====

0. Return to Main Menu

1. Planting Date .....] JUN 15
2. Year of Planting .....] 1978
3. Plant Population .....] 29.900
4. Row Spacing .....] 91.000
5. Row Direction .....] .000
6. Planting Depth .....] 4.000
7. Planting Material Dry Weight .....] -99.000
8. Planting Method .....] SEED
9. Planting Management .....] ON REPORTED DATE
10. Automatic Planting Options .....]

SELECTION (#) ? [ Default = 0 ] --->

```

SCREEN 38.

In Screen 38, Options 1 and 2, “Planting Date” and “Planting Year,” respectively, allow the user to modify the planting date and year.

Options 3 and 4, “Plant Population” and “Row Spacing,” respectively, allow the user to define plant density, row spacing and plant spacing.

Option 5, "Row Direction," is used only in the grain legume models to define light interception for the simulated leaf level photosynthesis processes.

Option 6, "Planting Depth," affects germination and emergence.

Option 7, "Planting Material Dry Weight," allows the user to define the initial weight of the root crops at planting.

Option 8, “Planting Method,” allows the user to define planting method, strategy (e.g., seed, transplant, etc.)

HARVEST

The “Harvest Timing and Control” menu allows the user to define the conditions for crop harvesting. The default for harvest is when the crop reaches harvest maturity, as shown in Screen 40 (below).

```

HARVEST TIMING AND CONTROL
=====

0. Return to Main Menu                                AT HARVEST MATURITY
                                                    -9      -9

1. Harvest Management .....]
2. Harvest Date .....]
3. Harvest Days after Planting .....]
4. Harvest Stage .....]    -9
5. Harvest Component .....]    Harvest
6. Harvest Size Group .....]
7. Harvest Percentage .....]    100.
8. Automatic Harvest Options .....]

SELECTION (#) ? [ Default = 0 ] --->

```

SCREEN 40.

In Screen 40, Option 1, “Harvest Management,” allows the user to define various management options. If this option is selected, Screen 41 (on following page) is presented.

Option 2, "Harvest Date," is active only when, in Screen 41, the user selects Option 2, "On Reported Date(s)." Then, Screen 40 is presented again and the user can select Option 2 and enter the harvest date.

Option 3, "Harvest Date After Planting," is active only when, in Screen 41, the user selects Option 3, "On Reported Days After Planting." Then, Screen 40 is presented again and the user can select Option 3 and enter the number of days after planting for the harvest date.

Option 4, "Harvest Stage," allows the user to select the phenological or development stage at which to harvest the crop and terminate the simulation.

Options 5, 6 and 7, "Harvest Component," "Harvest Size Group" and Harvest

Screen 42 shows the various conditions which can be set when the automatic harvest management option is selected in Screen 40.

The “Water and Irrigation Management and Modification” menu allows the user to modify the various options and variables associated with the water balance simulation and irrigation applications (Screen 43, below).

```

WATER AND IRRIGATION MANAGEMENT AND MODIFICATION
=====

0. Return to Main Menu

1. Water Balance Simulation .....] Y
2. Irrigation Management .....] ACCORDING TO FIELD SCHEDULE
3. Automatic Irrigation Control .....] -9.000 -9.0
4. Automatic Irrigation-Fixed Amount..] -9.000 mm
5. Irrigation Efficiency .....] .75
6. Enter Irrigation Interactive .....]
7. Water Output File .....] Y

SELECTION ? [ Default = 0 ] ==>

```

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Option 3 selects to refill the selected profile depth to the drained upper limit or field capacity.

Option 5, “No Water Stress/No Water Balance Simulation,” allows the user to choose not to simulate the soil water balance, which is the same as setting the water balance simulation to ‘N’ in Screen 43.

SCREEN 45.

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NITROGEN

The “Nitrogen Management and Modification” menu allows the user to modify variables and options associated with the soil nitrogen simulation (Screen 46, below).

```
NITROGEN MANAGEMENT AND MODIFICATION
=====

0. Return to Main Menu

1. Nitrogen Balance Simulation .....] Y
2. N-Fertilizer Management .....] NOT FERTILIZED
3. Automatic Fertilizer Management ...]
4. Enter N-Fertilizer Interactive ....]
5. Nitrogen Fixation .....] N-FIX SIMULAT.
6. Nitrogen Fixation Characteristics..]
7. Nitrogen Output File .....] Y

SELECTION ? [ Default = 0 ] ==>
```

SCREEN 46.

Option 1, “Nitrogen Balance Simulation,” allows the user to turn the soil nitrogen balance simulation on or off. Note that the water balance simulation must be set to ‘Y’ to simulate the soil nitrogen balance.

Option 2, “N-Fertilizer Management,” allows the user to define the various nitrogen fertilizer management options. When this option is selected, Screen 47 (on following page) is presented.

Option 3 in Screen 48, “Automatic Fertilizer Management,” can only be accessed if Option 3, “Automatic N-Fertilizer Application” in Screen 47, is selected. When Option 3 in Screen 47 is selected, Screen 48 is presented. The user makes his selection(s) in Screen 48 and a ‘Y’ is placed next to Option 3 in Screen 46.

Option 4, “Enter N-Fertilizer Interactive,” can only be accessed if Option 2, “Apply N-Fertilizer According to Field Schedule” in Screen 47, is selected. The screen which defines interactive N-fertilizer applications is not shown, but is similar to the screen for irrigation management (Screen 45, on preceding page).

Option 7, "Nitrogen Output File," allows the user to either switch the soil and plant nitrogen output file on or off.

SCREEN 47.

In the latter case, the nitrogen fertilizer data must be in FILEX. Please note that Option 4 in Screen 46, "Enter N-Fertilizer Interactive" can only be accessed if Option 2 in Screen 47 is selected. (See Option 4 for screen 46.)

Option 4 in Screen 47 allows the user to choose not to simulate the soil nitrogen balance, which is the same as setting Option 1 to 'N' in Screen 46.

SCREEN 48.

Screen 48 shows the various threshold levels which can be set for automatic nitrogen fertilizer applications. In this screen, the threshold value (Option 1) uses a nitrogen factor expressed on a relative basis between 0 and 100 percent, where “0” means that the plants are under complete nitrogen stress and “100” means that the plants are under no nitrogen stress.

Options 2, 3 and 4 allow the user to define the amount of nitrogen fertilizer to be applied, the application depth, and the type of nitrogen fertilizer, respectively, when the crop model calls for a nitrogen fertilizer application, as selected under the threshold level of Option 1.

SCREEN 49.

In Screen 49, Option 1, “No Nitrogen Fixation Simulation,” allows the user to simulate a complete soil and plant nitrogen balance. However, plants will not fix nitrogen, which is similar to non-nodulating cultivars.

Option 3, “Unlimited Nitrogen Fixation Simulation,” allows the user to simulate a dynamic nitrogen uptake and assumes that the remainder of the nitrogen required for growth is available via N fixation.

Screen 50 shows the nitrogen fixation characteristics which can be modified when Option 6 in Screen 46 is selected.

In Screen 50, Option 1, "Rhizobia Effectiveness," is a relative number between 0 and 1. An effectiveness of "1" means that the rhizobia are completely active with respect to nitrogen fixation.

Option 2, “Rhizobia Number,” is also a relative number (0 to 1) which allows the user to determine the initial amount of rhizobia present at the start of simulation.

The “Phosphorus Management and Modification” menu is under development and is not available for the current DSSAT v3 crop models.

```

CROP RESIDUE MANAGEMENT AT START OF SIMULATION
=====

0. Return to Main Menu

1. Residue Application Date .....]      78166
2. Residue Applied at Start of Simulation .....] 1000.0 kg/ha
3. Residue Nitrogen Concentration .....]      .80 %
4. Residue Phosphorus Concentration .....]      .00 %
5. Residue Incorporation .....] 100.00 %
6. Residue Incorporation Depth .....]      15.0 cm
7. Residue Material Code .....]      IB001
8. Root Weight from Previous Crop .....] 100.00 kg/ha
9. Nodule Weight from Previous Crop .....]      .00 kg/ha
10. Previous Crop .....]      SB

SELECTION (#) ? [ Default = 0 ] --->

```

In Screen 51, Option 1, “Residue Application Date,” uses the same date as the start of simulation date.

Options 8 and 9, "Root Weight from Previous Crop" and "Nodule Weight from Previous Crop," respectively, allows the user to enter these values. Please note that the program assumes that all below ground material from a previous crop remains in the soil.

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CROP PROCESS OPTIONS

The “Simulation Control and Modification” menu allows the user to control various internal process simulations of the models (Screen 53, below).

```

SIMULATION CONTROL AND MODIFICATION
=====

0. Return to Main Menu

1. Water Balance Simulation .....] Y
2. Nitrogen Balance Simulation .....] Y
3. Nitrogen Fixation Simulation .....] N-FIX SIMULAT.
4. Phosphorus Balance Simulation .....] N
5. Pest and Disease Interaction Simulation ..] Y
6. Weather Input Method .....] OBSERVED DATA
7. Initial Conditions .....] AS REPORTED
8. Photosynthesis Simulation Method .....] CANOPY PHOT
9. Evaporation Simulation Method .....] PRIESTLEY-TAYLOR

SELECTION ? [ Default = 0 ] ==>

```

SCREEN 53.

In Screen 53, Options 1, 2, 3, 4, 5, 6 and 7 can be modified in their respective menus. For example, the options for the Water Balance simulation (Option 1) and Nitrogen Balance simulation (Option 2), can be found in the “Water and Irrigation” and “Nitrogen” sections, respectively, of this Chapter. Please note that Options 3, 5 and 8 are crop model or species specific.

Option 3, "Summary Output File," allows the user to control the output file, SUMMARY.OUT. A 'Y' selection for this file will erase the file from the previous run and will create a new output file; an 'A' selection for this file will append the outputs of the current simulation to the already existing SUMMARY.OUT file and no headers will be written. A 'N' will cause this file not to be created.

Option 5, "Carbon Balance Output File," allows the user to control the output file, CARBON.OUT.

Option 7, "Nitrogen Balance Output File," allows the user to control the output file, NITROGEN.OUT.

Option 9, “Pest Output File,” allows the user to control the output file, PEST.OUT. Please note that this option is available only in the grain legume models.

Option 11, “Save Output Files with Experiment Code,” allows the user to save the files using the same file name as FILEX for that experiment, except for its last character, which must be a G, W, N, C, P or D, for growth, water, nitrogen, carbon, phosphorus, and pests and diseases, respectively. The default setting for Option 11 is ‘N’.

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- The weather file. This file is normally located either in the crop data directory or in the weather data directory of DSSAT v3 (C:\DSSAT3\WEATHER). Look for a file with the WTH extension, using the file name convention ???????.WTH, where ??????? includes the institute code, site code, and year, e.g., UFGA7801.WTH.
- The crop species in the *CULTIVAR section of FILEX is wrong. Check the code under “CR” in the *CULTIVAR section.
- The cultivar specified in the *CULTIVAR section is wrong or not included in the genotype file of the model. Check the code under INGENO in the *CULTIVAR section of FILEX. Also check the genotype file ??????.CUL. If the cultivar is currently not included in this file, use the genotype calculator program to add this cultivar to the cultivar list and to estimate the initial values for all genetic coefficients.
- The weather station specified in the *FIELDS section is wrong or the file is not included in either the model data directory or weather data directory. Check the code under WSTA in the *FIELDS section of FILEX.
- The soil profile identified in the *FIELDS section is wrong or the soil profile is not part of the soil file SOIL.SOL. Check the section under ID_SOIL in the *FIELDS section of FILEX.

Required model input data are explained in detail in Volume 2-1 (Jones et al., 1994) of this book, and example files are included with the required variables highlighted for the various options available for simulation.

The input section of the model includes detailed error checking routines. The most common error messages are listed in Table 7. These messages include the subroutine and the input file in which the error occurred, and in some cases also the line number of the input file. These messages also give you some information about the type of error which occurred. In many cases these errors can be corrected by editing FILEX using either the XCreate program (see Volume 1-4, Imamura 1994, of this book) or any other ASCII text editor.

There might be cases where the model gives a runtime error. These errors could either be due to a problem with the input file, such as a “0” where the model expects a number > 0 , or other problems. However, in some cases, these errors can be caused by a combination of inputs which we have been unable to test during model development. If this happens, please make sure that your error is reproducible; that is, you can recreate the same error and error message using the same combination of input conditions. Please carefully document the problem, error message, combination of inputs and input files, and model version number and contact one of the model developers, a listing of whom can be found in Appendix D.


```
IPSLAN      1
Initial soil analysis section not found. Please add to input file.
```

IPSLAN 2
Error in initial soil analysis inputs. Check format.

IPSLAN 10
Error in initial bulk density inputs. Please check data.

IPSLAN 11
Error in initial organic carbon inputs. Please check data.

IPSLAN 12
Error in initial nitrogen inputs. Please check data.

```
IPSLIN      1
Initial soil input section not found. Please add to input file.
```

IPSLIN 2
Error in initial soil inputs. Check format.

IPSLIN 10
Error in initial soil water inputs. Please check data.

IPSLIN 11
Error in initial NH4 inputs. Please check data.

IPSLIN 12
Error in initial N03 inputs. Please check data.

```
IPSLIN      13
Error in initial residue weight inputs. Please check data.
```

```
IPSLIN      1.4
Error in initial residue nodule weight inputs. Please check data.
```

IPSLIN 15
Error in inoculation efficiency data. Please check data.

IPSLIN 16
Error in fixation efficiency data. Please check data.

IPSIM 1
Simulation control section not found. Please add to input file.

IPSIM 2
Incorrect number of lines in simulation control section. Check format.

IPSIM 3
Impossible combination--for MEEVP='Z', MEPHO must be 'L'.

IPS0IL 1
Error in Soil Selection entry. Fix entry or batch file.

IPS0IL²
More than 19 layers in the soil profile. Correct input file.

IPSOIL 3
Error in Soil Selection entry. Fix soil input file.

IPS0IL 4
End of soil file. Please add missing information to input file.

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PHOTOSYNTHESIS CALCULATION OPTIONS (GRAIN LEGUME MODELS ONLY)

CARBON DIOXIDE EFFECTS

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coefficients for soybean than SOYGRO V5.42. A second file is the ECOTYPE file; for example, SBGRO940.ECO, which contains coefficients that are thought to change among GROUPS of cultivars, but not for every cultivar. Thus the number of coefficients that have to be estimated for a new cultivar was reduced to 15. Since the coefficients in this file have to be estimated for each cultivar that is to be simulated, they are discussed in more detail in Appendix A of this Part. A third file of parameters is the SPECIES file, designated by SPE, for example SBGRO940.SPE. This file is equivalent to the CROPPARM file in the earlier GRO models. In the naming convention for the cultivar file, ecotype file, and species file, the first two characters correspond to a particular species, and the following six characters represent the model used and its version number. For instance, the file, SBGRO940.*, designates the Soybean species, ecotype, and cultivar input files used in the GRO model (CROPGRO) released in 1994.

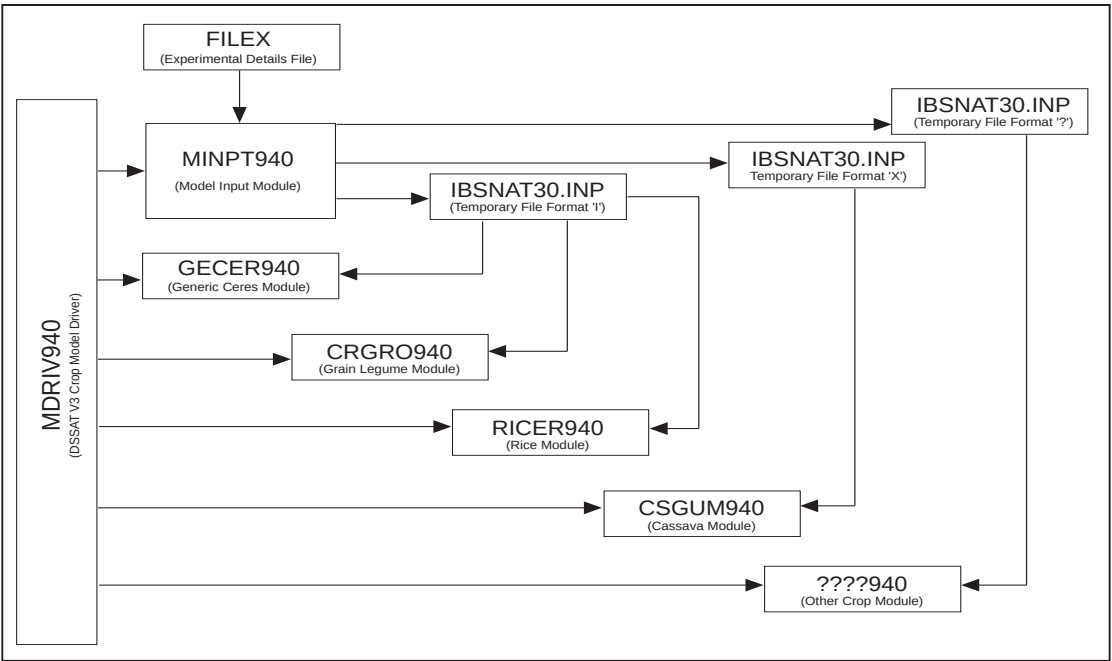
Both the generic CERES model and the CERES - Rice model use only the cultivar files and do not have either an ecotype file or a species file as input. The change in these models in DSSAT v3 from those of the older models is that the DSSAT v3 genetic files use the same file format as that of the new Input/Output file structures described in Volume 2-1 (Jones et.al 1994) of this book.

PEST EFFECTS (GRAIN LEGUME MODELS ONLY)

A generalized method for incorporating pest damage in the crop models was developed (Batchelor et al., 1993) for DSSAT v3. Twenty-one coupling points were identified in the CROPGRO model, and damage can be simulated by reducing various state and/or rate variables. Damage can also be induced by input or field-observed damage or for field-measured pest populations. Pest and pest damage coefficients are defined in a special pest input file (e.g., for soybean, SBGRO940.PST). These pest coefficients are defined through the coupling points in the crop model and the damage rates associated with a unit of pest input.

Field-observed pest damage or pest densities are input into the time course observed data file (FILET), which may include plant and soil variables, as well as pest damage levels (for example, UFGA8101.SBT). This approach was taken in order to facilitate a common way of handling field data in DSSAT v3. Users can also input hypothetical values of pest levels or pest damage in the time course file (FILEA) for an experiment in order to study damage effects on crop growth and yield. A detailed description of the method for incorporating pest damage into the DSSAT v3 models can be found in Appendix B of this Part.

Filetype “X” is identical to the current Input/Output file format of FILEX, except that it includes only information for one treatment, rather than an entire experiment. Filetype “T” is similar to the current Input/Output file format of FILEX,



All information shown in this file is required; if lines or headers are deleted the crop simulation models will not run.

The section “*FILES” includes the name and path for respectively the crop simulation module, FILEX, FILEA, FILET, species file, ecotype file, cultivar file, pest file, soils file, weather file, and output files.

The section “*EXP.DETAILS” is identical to the experiment details section of FILEX, except for no header information.

The sections “*CULTIVARS”, “*FIELDS”, “*INITIAL CONDITIONS”, “*PLANTING DETAILS”, “*IRRIGATION”, “*FERTILIZERS”, “*RESIDUES”, “*ENVIRONMENT” and “*HARVEST” all only include the information for the actual treatment level which is simulated. The information for the other levels has been eliminated, and all headers have been deleted. If a particular section does not have any levels, such as “*HARVEST” shown in the example, the actual section header still needs to be included.

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tion, names, soil surface and soil layer information for the soil selected under the “*FIELDS” section. A blank line delineates the information for the first and second tier. The format is the same as the format of the data stored in the actual soil profile file, except for the headers.

The “*CULTIVAR” section includes all the values of the variables for the particular cultivar selected under the “*CULTIVAR” section discussed earlier. The format is the same as the format of the data stored in the actual cultivar file, except for the headers.

The user needs to be aware that the crop simulation modules do not include error checking procedures. If the user decides to modify the format of this temporary file, or creates his own temporary file through different procedures, we can not guarantee that the crop simulation module will work properly.

*IRRIGATION															
	.750	-99.	-99.	-99.	-99	-99	.0								
78181	IR001	13.	0												
78230	IR001	13.	0												
78235	IR001	13.	0												
78237	IR001	13.	0												
78240	IR001	11.	0												
78242	IR001	11.	0												
78244	IR001	11.	0												
78246	IR001	11.	0												
78250	IR001	11.	0												
78253	IR001	11.	0												
78256	IR001	8.	0												
78259	IR001	8.	0												
78262	IR001	8.	0												
78265	IR001	8.	0												
78269	IR001	7.	0												
78272	IR001	8.	0												
78279	IR001	7.	0												
78283	IR001	8.	0												
78294	IR001	10.	0												
*FERTILIZERS															
*RESIDUES															
78166	RE001	1000	.80	.00	.00	100.	15.								
*ENVIRONMENT															
*HARVEST															
*SOIL															
IBSB910015 SCS FSA 180. Millhopper Fine Sand															
Gainesville USA 29.630 -82.370 Loamy,silic,hyperth Gross. Paleudults (15)															
.18	5.0	.50	66.	1.00	.84	IB001	IB001	IB001							
5.	.023	.086	.230	1.000	7.4	1.36	.90	-99.0	-99.0	-99.0	.00	5.3	-99.0	-99.0	
15.	.023	.086	.230	1.000	7.4	1.40	.69	-99.0	-99.0	-99.0	.00	5.4	-99.0	-99.0	
30.	.023	.086	.230	.498	15.8	1.46	.28	-99.0	-99.0	-99.0	.00	5.7	-99.0	-99.0	
45.	.023	.086	.230	.294	28.0	1.47	.20	-99.0	-99.0	-99.0	.00	5.8	-99.0	-99.0	
60.	.023	.086	.230	.294	27.6	1.47	.20	-99.0	-99.0	-99.0	.00	5.8	-99.0	-99.0	
90.	.021	.076	.230	.380	17.5	1.43	.09	-99.0	-99.0	-99.0	.00	5.9	-99.0	-99.0	
120.	.020	.076	.230	.133	.3	1.48	.03	-99.0	-99.0	-99.0	.00	5.9	-99.0	-99.0	
150.	.027	.130	.230	.062	.1	1.57	.03	-99.0	-99.0	-99.0	.00	5.9	-99.0	-99.0	
180.	.070	.258	.360	.031	.0	1.79	.03	-99.0	-99.0	-99.0	.00	5.9	-99.0	.0	
5.	.0	.0	.0	.0	.0	.0	.0	.0							
15.	.0	.0	.0	.0	.0	.0	.0	.0							
30.	.0	.0	.0	.0	.0	.0	.0	.0							
45.	.0	.0	.0	.0	.0	.0	.0	.0							
60.	.0	.0	.0	.0	.0	.0	.0	.0							
90.	.0	.0	.0	.0	.0	.0	.0	.0							
120.	.0	.0	.0	.0	.0	.0	.0	.0							
150.	.0	.0	.0	.0	.0	.0	.0	.0							
180.	.0	.0	.0	.0	.0	.0	.0	.0							
*CULTIVAR															
IB0001 BRAGG (7) SB0701 12.33 .320 19.50 10.00 15.00 35.50 15.00 1.022 350.0 170.0 1.00 .180															

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*BARLEY GENOTYPE COEFFICIENTS - GECER940 MODEL

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IB0055	Larker (6)	IB0001	.5	1.0	3.5	4.0	3.0	4.0	95.00
IB0056	Robust (6)	IB0001	.5	1.0	3.5	4.0	3.0	4.0	95.00
IB0057	Summit (2)	IB0001	.5	1.0	3.5	4.0	3.0	2.0	95.00
IB0058	Bowman (6)	IB0001	.5	1.0	3.5	4.0	3.0	4.0	95.00
IB0059	Hazen (6)	IB0001	.5	1.0	3.5	4.0	3.0	4.0	95.00
IB0101	A. Abiad (2)	IB0001	.5	3.0	4.0	3.5	4.0	2.0	95.00
IB0102	Beecher (6)	IB0001	.5	2.5	4.0	2.2	3.5	4.0	95.00
IB0103	Algerie (2)	IB0001	.5	3.0	3.0	2.0	2.0	2.0	95.00

TABLE 10. GENETIC COEFFICIENTS FILE FOR CERES-MAIZE. (MZCER940.CUL)

*MAIZE GENOTYPE COEFFICIENTS - GECER940 MODEL								
@VAR#	VRNAME	ECO#	P1	P2	P5	G2	G3	PHINT
!			1	2	3	4	5	6
IB0001	CORN1281	IB0001	110.0	0.300	685.0	825.4	6.60	75.00
IB0002	CP170	IB0001	120.0	0.000	685.0	825.4	10.00	75.00
IB0003	LG11	IB0001	125.0	0.000	685.0	825.4	10.00	75.00
IB0004	F7 X F2	IB0001	125.0	0.000	685.0	825.4	10.00	75.00
IB0005	PIO 3995	IB0001	130.0	0.300	685.0	825.4	8.60	75.00
IB0006	INRA	IB0001	135.0	0.000	685.0	825.4	10.00	75.00
IB0007	ED0	IB0001	135.0	0.300	685.0	825.4	10.40	75.00
IB0008	A654 X F2	IB0001	135.0	0.000	685.0	825.4	10.00	75.00
IB0009	DEKALB XL71	IB0001	140.0	0.300	685.0	825.4	10.50	75.00
IB0010	F478 X W705A	IB0001	140.0	0.000	685.0	825.4	10.00	75.00
IB0011	DEKALBXL45	IB0001	150.0	0.400	685.0	825.4	10.15	75.00
IB0012	PIO 3382	IB0001	160.0	0.700	890.0	750.0	8.50	75.00
IB0013	B59*0H43	IB0001	162.0	0.800	685.0	784.0	6.90	75.00
IB0014	F16 X F19	IB0001	165.0	0.000	685.0	825.4	10.00	75.00
IB0015	WASHINGTON	IB0001	165.0	0.400	715.0	750.0	11.00	75.00
IB0016	B14X0H43	IB0001	172.0	0.300	685.0	825.4	8.50	75.00
IB0017	R1*(N32*B14)	IB0001	172.0	0.800	685.0	825.4	10.15	75.00
IB0018	B60*R71	IB0001	172.0	0.800	685.0	710.4	7.70	75.00
IB0019	WF9*B37	IB0001	172.0	0.800	685.0	825.4	10.15	75.00
IB0020	B59*C103	IB0001	172.0	0.800	685.0	825.4	10.15	75.00
IB0021	Garst 8702	IB0001	175.0	0.200	960.0	778.0	6.00	75.00
IB0022	B14*C103	IB0001	180.0	0.500	685.0	825.4	10.15	75.00
IB0023	B14*C131A	IB0001	180.0	0.500	685.0	825.4	10.15	75.00
IB0024	PIO 3720	IB0001	180.0	0.800	685.0	825.4	10.00	75.00
IB0025	WASH/GRAIN-1	IB0001	185.0	0.400	775.0	760.0	12.00	75.00
IB0026	A632 X W117	IB0001	187.0	0.000	685.0	825.4	10.00	75.00
IB0027	Garst 8750	IB0001	190.0	0.200	930.0	810.0	6.30	75.00
IB0028	TAINAN-11	IB0001	200.0	0.800	670.0	730.0	6.80	75.00
IB0029	PIO 3541	IB0001	200.0	0.300	800.0	700.0	8.50	75.00
IB0030	PIO 3707	IB0001	200.0	0.700	800.0	590.0	6.30	75.00
IB0031	PIO 3475	IB0001	200.0	0.700	800.0	725.0	8.60	75.00
IB0032	PIO 3382	IB0001	200.0	0.700	800.0	650.0	8.50	75.00
IB0033	PIO 3780	IB0001	200.0	0.760	685.0	600.0	9.60	75.00
IB0034	PIO 3780*	IB0001	200.0	0.760	685.0	725.0	9.60	75.00
IB0035	McCurdy 84aa	IB0001	200.0	0.300	940.0	700.0	8.00	75.00
IB0036	C281	IB0001	202.0	0.300	685.0	825.4	5.80	75.00
IB0037	SWEET CORN	IB0001	210.0	0.520	625.0	825.0	10.00	75.00
IB0038	Garst 8555	IB0001	215.0	0.400	890.0	800.0	9.00	75.00
IB0039	PIO 3901	IB0001	215.0	0.760	600.0	560.0	9.00	75.00
IB0040	B8*153R	IB0001	218.0	0.300	760.0	575.0	8.80	75.00

IB0041	Garst 8808	IB0001	220.0	0.400	780.0	780.0	8.50	75.00
IB0042	B73 X M017	IB0001	220.0	0.520	880.0	730.0	10.00	75.00
IB0043	PIO 511A	IB0001	220.0	0.300	685.0	645.0	10.50	75.00
IB0044	W69A X F546	IB0001	240.0	0.300	685.0	825.4	10.00	75.00
IB0045	A632 X VA26	IB0001	240.0	0.300	685.0	825.4	10.00	75.00
IB0046	W64A X W117	IB0001	245.0	0.000	685.0	825.4	8.00	75.00
IB0047	PIO 3147	IB0001	255.0	0.760	685.0	834.0	10.00	75.00
IB0048	WF9*B37	IB0001	260.0	0.800	710.0	825.4	6.50	75.00
IB0049	NEB 611	IB0001	260.0	0.300	720.0	825.0	9.00	75.00
IB0050	PV82S	IB0001	260.0	0.500	750.0	600.0	8.50	75.00
IB0051	PV76S	IB0001	260.0	0.500	750.0	600.0	8.50	75.00
IB0052	PIO 3183	IB0001	260.0	0.500	750.0	600.0	8.50	75.00
IB0053	CESDA-28	IB0001	260.0	0.500	669.0	780.0	7.10	75.00
IB0054	B14*0H43	IB0001	265.0	0.800	665.0	780.0	6.90	75.00
IB0055	MCCURDY 6714	IB0001	265.0	0.300	825.0	825.4	9.80	75.00
IB0056	FM 6	IB0001	276.0	0.520	867.0	616.0	10.70	75.00
IB0057	TOCORON-3	IB0001	276.0	0.520	867.0	600.0	8.12	75.00
IB0058	NC+59	IB0001	280.0	0.300	750.0	825.0	10.00	75.00
IB0059	H6	IB0001	310.0	0.300	685.0	825.4	10.00	75.00
IB0060	H610(UH)	IB0001	300.0	0.520	920.0	580.0	6.40	75.00
IB0061	PB 8	IB0001	300.0	0.520	990.0	400.0	7.00	75.00
IB0062	B56*C131A	IB0001	318.0	0.500	700.0	805.0	6.40	75.00
IB0063	PIO X 304C	IB0001	320.0	0.520	940.0	625.0	6.00	75.00
IB0064	H.OBREGON	IB0001	360.0	0.800	685.0	825.4	10.15	75.00
IB0065	SUWAN-1	IB0001	380.0	0.600	780.0	750.0	7.00	75.00

VAR#	Identification code xor number for a specific cultivar
VAR-NAME	Name of cultivar
ECO#	Ecotype code for this cultivar, points to the Ecotype in the ECO file (currently not used).
P1	Thermal time from seedling emergence to the end of the juvenile phase (expressed in degree days above a base temperature of 10°C) during which the plant is not responsive to changes in photoperiod.
P2O	Critical photoperiod or the longest day length (in hours) at which development occurs at a maximum rate. At values greater than P2O, the rate of development is reduced.
P2R	Extent to which phasic development leading to panicle initiation (expressed in degree days) is delayed for each hour increase in photoperiod above P2O.
P5	Thermal time (degree days above a base temperature of 10°C) from beginning of grain filling (3-4 days after flowering) to physiological maturity.
G1	Scaler for relative leaf size.
G4	Scaler for partitioning of assimilates to the panicle (head).
PHINT	Phylochron interval; the interval in thermal time (degree days) between successive leaf tip appearances.

CERES-SORGHUM

Table 12 shows an example of the current cultivars defined for sorghum.

Required genetic coefficients include :

VAR#	Identification code or number for a specific cultivar.
VAR-NAME	Name of cultivar.
ECO#	Ecotype code for this cultivar, points to the Ecotype in the ECO file (currently not used).
P1	Thermal time from seedling emergence to the end of the juvenile phase(expressed in degree days above a base temperature of 8°C) during which the plant is not responsive to changes in photoperiod.
P2O	Critical photoperiod or the longest day length (in hours) at which development occurs at a maximum rate. At values higher than P2O, the rate of development is reduced.
P2R	Extent to which phasic development leading to panicle initiation (expressed in degree days) is delayed for each hour increase in photoperiod above P2O.
P5	Thermal time (degree days above a base temperature of 8°C) from beginning of grain filling (3-4 days after flowering) to physiological maturity.
G1	Scaler for relative leaf size.
G2	Scaler for partitioning of assimilates to the panicle (head).
PHINT	Phylochron interval; the interval in thermal time (degree days) between successive leaf tip appearances.

TABLE 12. GENETIC COEFFICIENTS FILE FOR CERES-SORGHUM. (SGCER940.CUL)

*SORGHUM GENOTYPE COEFFICIENTS - GECER940 MODEL

@VAR#	VRNAME	ECO#	P1	P20	P2R	P5	G1	G2	PHINT
!			1	2	3	4	5	6	7
IB0001	RIO	IB0001	430.0	11.60	24.0	540.0	.0	6.0	49.00
IB0002	9188	IB0001	393.0	13.00	23.0	540.0	.0	6.0	49.00
IB0003	BRANDES	IB0001	374.0	11.00	116.0	540.0	.0	6.0	49.00
IB0004	MN1500	IB0001	495.0	11.80	139.0	540.0	.0	6.0	49.00
IB0005	HEGARI	IB0001	273.0	11.50	136.0	540.0	.0	6.0	49.00
IB0006	100M	IB0001	291.0	11.00	127.0	540.0	.0	6.0	49.00
IB0007	80M	IB0001	337.0	12.60	262.0	540.0	.0	6.0	49.00
IB0008	60M	IB0001	337.0	12.80	290.0	540.0	.0	6.0	49.00
IB0009	SM100	IB0001	365.0	13.00	45.0	540.0	.0	6.0	49.00
IB0010	SM80	IB0001	356.0	12.00	74.0	540.0	.0	6.0	49.00
IB0011	SM60	IB0001	365.0	12.20	74.0	540.0	.0	6.0	49.00
IB0012	REDLON	IB0001	393.0	12.50	30.0	540.0	.0	6.0	49.00
IB0013	CAPROCK	IB0001	393.0	12.80	84.0	540.0	.0	6.0	49.00
IB0014	ATx378XRTx7000	IB0001	384.0	11.30	24.0	540.0	.0	6.0	49.00
IB0015	ATx623	IB0001	380.0	13.00	35.0	540.0	.0	6.0	49.00
IB0016	RTx430	IB0001	400.0	13.00	123.0	540.0	.0	6.0	49.00
IB0017	ATx623XRTx430	IB0001	390.0	13.00	35.0	540.0	.0	6.0	49.00
IB0018	BTx3197	IB0001	411.0	13.00	108.0	540.0	.0	6.0	49.00
IB0019	RTx7078	IB0001	421.0	14.40	221.0	540.0	.0	6.0	49.00
IB0020	TX 610	IB0001	180.0	16.50	1.0	580.0	22.0	6.0	49.00
IB0021	WHEATLAND	IB0001	365.0	12.50	30.0	540.0	.0	6.0	49.00
IB0022	ATx399XRTx430	IB0001	393.0	12.80	40.0	540.0	.0	6.0	49.00
IB0023	ATx378XRTx430	IB0001	411.0	12.50	20.0	540.0	.0	6.0	49.00
IB0024	ATx623XRTx7000	IB0001	374.0	13.00	14.0	540.0	.0	6.0	49.00
IB0025	38M	IB0001	291.0	13.00	12.0	540.0	.0	6.0	49.00
IB0026	CSH-1	IB0001	410.0	13.60	40.0	540.0	3.0	5.5	49.00
IB0027	DE KALB 46	IB0001	325.0	15.50	30.0	540.0	9.0	6.0	49.00
IB0028	PIONEER 8333	IB0001	325.0	15.50	30.0	540.0	11.0	6.0	49.00
IB0029	DK	IB0001	200.0	15.50	12.0	540.0	.0	6.0	49.00
IB0030	PIONEER 8515	IB0001	275.0	15.50	30.0	500.0	.0	6.0	49.00
IB0031	RS 626	IB0001	300.0	15.50	30.0	400.0	.0	6.0	49.00
IB0032	DK- E57	IB0001	325.0	15.50	30.0	450.0	13.0	6.0	49.00
IB0040	RS610	IB0001	460.0	12.50	90.0	600.0	5.0	6.0	49.00
IB0041	NK212	IB0001	420.0	15.50	30.0	500.0	13.0	6.0	49.00
IB0042	PIONEER 846	IB0001	480.0	12.50	190.0	650.0	5.0	5.0	49.00
IB0043	CSH-6	IB0001	410.0	13.60	40.0	510.0	7.0	4.5	49.00
IB0044	CSH-6	IB0001	320.0	13.50	180.0	540.0	7.0	5.5	49.00
IB0046	M-35-1	IB0001	320.0	14.00	45.6	556.0	15.0	4.5	49.00
IB0047	SPV-504	IB0001	310.0	13.00	35.0	554.0	15.0	4.5	49.00
IB0048	CSH-5	IB0001	255.0	13.50	40.5	490.0	10.0	5.5	49.00
IB0049	CSH-9	IB0001	225.0	13.50	45.1	573.0	10.0	5.5	49.00
IB0050	SPH-388	IB0001	232.0	12.50	43.7	590.0	10.0	4.5	49.00

VAR#	Identification code or number for a specific cultivar.
VAR-NAME	Name of cultivar.
ECO#	Ecotype code for this cultivar, points to the Ecotype in the ECO file (currently not used).
P1V	Relative amount that development is slowed for each day of unfulfilled vernalization, assuming that 50 days of vernalization is sufficient for all cultivars.
P1D	Relative amount that development is slowed when plants are grown in a photoperiod 1 hour shorter than the optimum (which is considered to be 20 hours).
P5	Relative grain filling duration based on thermal time (degree days above a base temperature of 1°C), where each unit increase above zero adds 20 degree days to an initial value of 430 degree days.
G1	Kernel number per unit weight of stem (less leaf blades and sheaths) plus spike at anthesis (1/g).
G2	Kernel filling rate under optimum conditions (md/dy).
G3	Non-stressed dry weight of a single stem (excluding leaf blades and sheaths) and spike when elongation ceases (g).
PHINT	Phylochron interval; the interval in thermal time (degree days) between successive leaf tip appearances.

*WHEAT GENOTYPE COEFFICIENTS - GECER940 MODEL
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IB0548	TRISON	IB0001	6.0	2.7	2.0	2.8	1.6	1.9	95.00
IB0551	ARTHUR	IB0001	6.0	2.7	2.0	4.2	2.1	1.9	95.00
IB0552	TITAN	IB0001	3.0	2.0	4.5	4.3	3.1	1.9	95.00
IB0553	FRANKENMUTH	IB0001	6.0	2.7	2.0	3.8	1.6	1.9	95.00
IB0555	ISRAEL SW	IB0001	.5	3.0	4.5	2.9	4.7	2.6	95.00
IB0563	EAGLE	IB0001	6.0	3.5	2.0	3.2	3.0	1.9	95.00
IB0599	VONA	IB0001	6.0	3.1	2.5	3.9	1.6	1.7	95.00
IB0610	SAGE	IB0001	6.0	2.7	2.0	2.8	1.6	1.9	95.00
IB0700	BEZOSTAYA	IB0001	6.0	2.9	5.0	4.3	3.1	1.9	95.00
IB0701	MIRONOVSKAYA	IB0001	6.0	2.9	5.0	4.8	3.1	1.9	95.00
IB0702	ROUGH RIDER	IB0001	6.0	2.9	5.0	4.8	3.1	1.9	95.00
IB0777	ESTANZ. DORADO	IB0001	1.0	4.0	2.0	3.0	3.0	3.0	95.00
IB1001	ATLE	IB0001	6.0	2.7	2.0	1.3	1.6	1.9	95.00
IB1002	CAPELLE DESPREZ	IB0001	6.0	4.2	2.0	1.7	2.9	3.7	95.00
IB1003	JUFY 2	IB0001	6.0	2.7	2.0	2.8	1.6	1.9	95.00
IB1004	LELY	IB0001	6.0	3.5	2.0	4.8	2.8	4.4	95.00
IB1005	DONATA	IB0001	6.0	3.5	2.0	4.4	3.0	1.7	95.00
IB1006	MARIS HOBBIT	IB0001	6.0	2.7	2.0	3.6	3.1	3.6	95.00
IB1007	MARIS HUNTSMAN2	IB0001	6.0	2.9	2.0	3.9	3.9	2.2	95.00
IB1008	TALENT	IB0001	6.0	3.3	3.5	3.5	3.8	1.9	95.00
IB1009	HYSLOP	IB0001	6.0	2.7	2.0	3.0	1.6	1.9	95.00
IB1010	LUKE	IB0001	6.0	2.7	2.0	2.8	1.3	1.9	95.00
IB1011	ARMINDA	IB0001	6.0	2.7	2.0	4.3	4.6	1.9	95.00
IB1012	CAPITOLE	IB0001	6.0	3.2	2.5	3.1	3.6	1.0	95.00
IB1013	TOP	IB0001	6.0	3.5	3.5	3.2	3.3	1.9	95.00
IB1014	COURTOT	IB0001	6.0	3.3	2.5	3.4	3.1	1.0	95.00
IB1015	MARIS FUNDEN	IB0001	6.0	3.5	4.0	2.8	2.7	1.9	95.00
IB1015	STEPHENS	IB0001	6.0	3.3	2.5	3.5	6.8	2.7	95.00
IB1016	YAMHILL	IB0001	6.0	3.3	2.5	3.9	5.5	2.8	95.00
IB1017	MARIS HUNTSMAN	IB0001	6.0	3.5	4.0	3.9	3.0	2.2	95.00
IB1018	HD2160(INDIA)	IB0001	.5	3.3	2.5	4.0	2.9	2.4	95.00
IB1019	FARO	IB0001	6.0	3.3	2.5	4.3	4.9	2.6	95.00
IB1020	NIMBUS	IB0001	6.0	3.3	2.5	4.6	4.0	2.1	95.00
IB1021	SCHIROKKO	IB0001	.5	3.3	2.5	4.7	3.4	2.0	95.00
IB1022	ARKAS	IB0001	.5	3.3	2.5	4.0	3.1	2.1	95.00
IB1023	TURBO	IB0001	.5	3.3	2.5	4.8	3.3	2.1	95.00
IB1024	MARIS MARDLER	IB0001	6.0	3.3	2.5	4.8	3.3	2.1	95.00
IB1025	STARKEII	IB0001	6.0	3.3	1.0	4.0	2.4	2.1	95.00
IB1500	MANITOU	IB0001	.5	3.2	.0	4.9	1.8	1.7	95.00
IB1907	MEXIPAK	IB0001	.5	3.0	2.0	2.9	3.0	1.7	95.00
IB1908	SONALIKA	IB0001	.5	1.8	3.5	4.0	1.9	1.7	95.00
IB1909	NOVI SAD	IB0001	.5	3.5	2.0	4.0	1.3	1.7	95.00
IB2001	ANZA	IB0001	.5	3.4	2.0	3.5	2.7	4.4	95.00
IB2004	COKER 6815	IB0001	6.0	1.0	2.0	4.1	3.1	1.9	95.00
IB2006	NADADORES	IB0001	.5	2.7	2.0	2.8	1.6	1.9	95.00
IB2008	PENJAMO	IB0001	.5	2.7	2.0	2.8	1.6	1.9	95.00
IB2011	PLAINSMAN	IB0001	6.0	2.7	2.0	2.8	1.6	1.9	95.00

IB2012	PRODURA	IB0001	.5	3.1	2.5	3.3	3.3	5.3	95.00
IB2013	TAMU	IB0001	6.0	2.7	2.0	2.8	1.6	1.9	95.00
IB2014	WALDRON	IB0001	.5	1.5	2.0	2.8	1.6	1.9	95.00
IB2123	EGRET	IB0001	.5	3.0	2.0	2.6	3.3	2.7	95.00
IB2124	WW33G	IB0001	.5	3.0	2.0	3.7	1.8	2.4	95.00
IB4000	SQUAREHD MASTER	IB0001	6.0	4.7	2.0	1.1	2.2	1.9	95.00
IB4001	JUFY1	IB0001	.5	3.0	2.0	1.8	2.5	3.9	95.00
IB9800	FREDERICK	IB0001	6.0	2.7	2.0	3.8	1.6	1.9	95.00

TABLE 14. GENETIC COEFFICIENTS FILE FOR CROPGRO-DRY BEAN. (BNGRO940.CUL)

*DRYBEAN GENOTYPE COEFFICIENTS - CRGR094 MODEL

@VAR#	VRNAME	ECO#	CSDL	PPSEN	EM-FL	FL-SH	FL-SD	SD-PM	FL-LF	LFMAX	SLAVR	SIZLF	XFRT	WTPSD	SFDUR	SDPDV	PODUR
!			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
990006	MesoAm Hab 2 & 3	MESIND	12.17	0.000	32.0	2.0	9.0	24.00	18.00	1.00	320.	133.0	1.00	0.230	14.0	5.20	8.0
990001	Andean Habit 1	ANDDET	12.17	0.050	24.5	2.0	11.0	25.50	16.00	1.00	295.	133.0	1.00	0.550	11.0	3.50	3.5
990002	Andean Habit 2	ANDIND	12.17	0.050	26.0	4.0	11.0	26.50	18.00	1.00	350.	133.0	1.00	0.600	11.0	3.50	3.5
990003	Andean Habit 3	ANDIND	12.17	0.050	30.0	4.5	9.5	28.00	22.00	1.00	350.	133.0	1.00	0.650	20.0	4.20	5.0
990004	Andean Habit 4	ANDIND	12.17	0.050	34.0	5.0	9.0	34.00	34.00	1.00	350.	133.0	1.00	0.650	22.0	5.20	6.0
990005	Meso Amer. Hab.1	MESDET	12.17	0.000	27.0	4.0	9.0	22.00	16.00	1.00	350.	133.0	1.00	0.230	16.0	5.20	5.0
990007	Mex Highland H 3	MEXHIL	12.17	0.050	27.0	4.0	8.0	26.00	20.00	1.00	350.	133.0	1.00	0.440	17.0	3.20	5.0
IB0001	Porillo Sintet	MESIND	13.17	0.008	32.0	2.0	9.0	23.00	18.00	1.00	320.	133.0	1.00	0.210	15.0	5.20	10.0
IB0002	BAT 477+	MESIND	12.17	0.000	32.0	2.0	9.0	24.00	18.00	1.00	320.	133.0	1.00	0.230	14.0	5.20	8.0
IB0003	Seafarer	MESDET	12.17	0.000	25.0	5.0	09.0	23.00	22.00	1.00	350.	133.0	1.00	0.180	17.0	5.00	8.0
IB0004	C-20	MESIND	12.17	0.000	32.0	5.0	09.0	24.00	22.00	1.00	350.	133.0	1.00	0.170	17.0	5.00	8.0
IB0005	BAT 881	MESIND	12.17	0.000	33.0	2.0	9.0	24.00	18.00	1.00	300.	133.0	1.00	0.230	14.0	5.20	8.0
IB0006	ICTA-Ostua	MESIND	12.17	0.000	27.0	3.0	8.0	23.00	22.00	1.00	295.	133.0	1.00	0.200	17.0	5.40	5.0
IB0007	Rabia de Gato	MESIND	12.17	0.040	24.0	3.0	8.0	21.00	22.00	1.00	295.	133.0	1.00	0.180	17.0	5.40	5.0
IB0008	TURBO-III	MESIND	12.17	0.050	30.0	4.0	9.0	23.00	22.00	1.00	295.	133.0	1.00	0.180	17.0	4.00	5.0
IB0010	Carioca (G4017)	MESIND	12.17	0.000	33.5	3.0	11.0	24.00	18.00	0.90	270.	133.0	1.00	0.250	15.0	5.00	6.5
IB0011	Isabella	ANDDET	12.17	0.000	25.0	3.0	8.0	20.00	9.00	1.00	295.	133.0	1.00	0.290	15.0	3.50	10.0
IB0012	Manitou	ANDDET	12.17	0.000	28.0	3.0	8.0	23.00	9.00	1.00	295.	133.0	1.00	0.550	15.0	3.50	10.0
IB0013	Redkloud	ANDDET	12.17	0.000	24.5	2.0	11.0	25.50	7.00	1.00	305.	133.0	1.00	0.550	11.0	3.50	3.5
IB0014	Canadian Wonder	ANDDET	12.17	0.000	24.5	2.0	11.0	25.50	7.00	1.00	295.	133.0	1.00	0.550	11.0	3.50	3.5

CROPGRO-PEANUT

Table 15 shows an example of the current cultivars defined for peanut. Required genetic coefficients include :

VARTY	Also VAR#; the identification code or number for a specific cultivar.
VRNAME	Name of cultivar.
ECONO	Also ECO#; the ecotype code for this cultivar, points to the Ecotype in the ECO (PNGRO940.ECO) file.
CSDVAR	Also CSDL; critical daylength below which reproductive development proceeds unaffected by daylength, and above which development rate is reduced in proportion to hours above CSDVAR (h).
PPSEN	Slope of relative rate of development for daylengths above CSDVAR, or sensitivity to photoperiod (1/h).
PH2T5	Also EM-FL; the time from end of juvenile phase to first flower in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).
PHTHRS(6)	Also FL-SH; the time from first flower to first peg, in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).
PHTHRS(8)	Also FL-SD the time from first flower to first seed in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).
PHTHRS(10)	Also SD-PM the time from first seed to physiological maturity in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).
PHTHRS(13)	Also FL-LF the time from first flower to end of leaf growth in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).

CROPGRO-SOYBEAN

Table 16 shows an example of the current cultivars defined for soybean. Required genetic coefficients include :

VARTY	Also VAR#; the identification code or number for a specific cultivar.
VRNAME	Name of cultivar.
ECONO	Also ECO#; the ecotype code for this cultivar, points to the Ecotype in the ECO (SBGRO940.ECO) file.
CSDVAR	Also CSDL; critical daylength below which reproductive development proceeds unaffected by daylength, and above which development rate is reduced in proportion to hours above CSDVAR (h).
PPSEN	Slope of relative rate of development for daylengths above CSDVAR, or sensitivity to photoperiod (1/h).
PH2T5	Also EM-FL; the time from end of juvenile phase to first flower in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).
PHTHRS(6)	Also FL-SH; the time from first flower to first pod greater than 0.5 cm in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).
PHTHRS(8)	Also FL-SD the time from first flower to first seed in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).
PHTHRS(10)	Also SD-PM the time from first seed to physiological maturity in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).
PHTHRS(13)	Also FL-LF the time from first flower to end of leaf growth in photothermal days, which is equal to the minimum duration under optimal temperature and photoperiod (photothermal days).

TABLE 16. GENETIC COEFFICIENTS FILE FOR CROPGRO-SOYBEAN. (SBGRO940.CUL)

*SOYBEAN GENOTYPE COEFFICIENTS - CRGRO940 MODEL

@VAR#	VRNAME	ECO#	CSDL	PPSEN	EM-FL	FL-SH	FL-SD	SD-PM	FL-LF	LFMAX	SLAVR	SIZLF	XFRT	WTPSD	SFDUR	SDPDV	PODUR
!			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
990001	M GROUP 1	SB0101	13.84	0.203	17.0	6.0	13.0	32.00	30.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990002	M GROUP 2	SB0201	13.59	0.249	17.4	6.0	13.5	33.00	30.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990003	M GROUP 3	SB0301	13.40	0.285	19.0	6.0	14.0	34.00	30.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990004	M GROUP 4	SB0401	13.09	0.294	19.4	7.0	15.0	34.50	30.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990005	M GROUP 5	SB0501	12.83	0.303	19.8	8.0	15.5	35.00	15.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990006	M GROUP 6	SB0601	12.58	0.311	20.2	9.0	16.0	35.50	15.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990007	M GROUP 7	SB0701	12.33	0.320	20.8	10.0	16.0	36.00	15.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990008	M GROUP 8	SB0801	12.07	0.330	21.5	10.0	16.0	36.00	15.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990009	M GROUP 9	SB0901	11.88	0.340	23.0	10.0	16.0	36.50	15.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990010	M GROUP 10	SB1001	11.78	0.349	23.5	10.0	16.0	37.00	15.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990011	M GROUP 000	SB0001	14.60	0.129	15.5	5.0	12.0	29.50	30.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990012	M GROUP 00	SB0001	14.35	0.148	16.0	5.0	12.0	30.00	30.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
990013	M GROUP 0	SB0001	14.10	0.171	16.8	6.0	13.0	31.00	30.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	10.0
UC0001	ALTONA (00)	SB0001	14.42	0.148	17.5	7.5	14.0	33.00	33.00	1.022	350.	180.0	1.00	0.18	16.0	2.05	12.0
UC0002	MAPLE ARROW (00)	SB0001	14.42	0.148	17.8	7.0	13.0	33.50	33.00	1.022	350.	180.0	1.00	0.18	16.0	2.05	10.5
UC0003	MCCALL (00)	SB0001	14.42	0.148	17.0	5.5	12.0	34.00	33.00	1.022	350.	180.0	1.00	0.18	16.0	2.05	9.0
IB0011	EVANS (0)	SB0001	14.00	0.171	16.8	6.5	12.4	33.00	31.00	1.022	360.	180.0	1.00	0.18	24.0	2.05	12.0
IB0037	ELGIN-87 (2)	SB0201	13.65	0.240	17.4	6.0	10.7	33.00	31.50	1.022	380.	150.0	1.00	0.18	20.0	2.05	10.0
IB0003	WAYNE (3)	SB0302	13.50	0.226	21.0	8.0	15.5	30.00	25.00	1.022	380.	135.0	1.00	0.16	20.0	2.20	21.0
IB0009	WILLIAMS (3)	SB0301	13.45	0.285	20.5	9.0	16.0	30.00	30.00	1.022	350.	120.0	1.00	0.18	24.0	2.50	15.0
IB0010	WILLIAMS-82 (3)	SB0301	13.45	0.285	19.5	8.0	15.0	31.50	30.00	1.022	350.	120.0	1.00	0.18	24.0	2.50	10.0
IB0043	CLARK (4)	SB0502	12.83	0.303	18.0	9.0	15.0	32.00	30.00	1.022	390.	200.0	1.00	0.18	20.0	2.10	12.0
IB0008	FORREST (5)	SB0501	12.83	0.303	22.6	7.0	14.5	33.00	15.00	1.022	350.	140.0	1.00	0.18	23.0	2.05	9.0
IB0001	BRAGG (7)	SB0701	12.33	0.320	19.5	10.0	15.0	35.50	15.00	1.022	350.	170.0	1.00	0.18	22.0	2.05	10.0
IB0006	RANSOM (7)	SB0701	12.37	0.320	18.0	10.0	16.0	32.00	15.00	1.022	350.	170.0	1.00	0.18	22.0	2.05	10.0
IB0002	COBB (8)	SB0801	12.25	0.330	21.0	9.0	16.0	37.00	15.00	1.022	380.	180.0	1.00	0.15	22.0	1.90	10.0
IB0033	PAPILLON (9)	SB0901	11.88	0.340	28.0	6.0	11.0	30.00	15.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	20.0
IB0012	JUPITER (10)	SB0901	11.88	0.340	28.9	7.0	13.5	31.50	15.00	1.022	350.	180.0	1.00	0.18	22.0	2.05	20.0

TABLE 17. GENETIC COEFFICIENTS FILE FOR CERES-RICE. (RICER940.CUL)

!@VAR#	GENOTYPE	COEFFICIENTS	-	RICER940	MODEL						
!	VAR-NAME.....	ECO#	P1	P2R	P5	P20	G1	G2	G3	G4	
!			1	2	3	4	5	6	7	8	
!											
IB0001	IR 8	IB0001	880.0	52.0	550.0	12.1	65.0	.0280	1.00	1.00	
IB0002	IR 20	IB0001	500.0	166.0	500.0	11.2	65.0	.0280	1.00	1.00	
IB0003	IR 36	IB0001	450.0	149.0	350.0	11.7	68.0	.0230	1.00	1.00	
IB0004	IR 43	IB0001	720.0	120.0	580.0	10.5	65.0	.0280	1.00	1.00	
IB0005	LABELLE	IB0001	318.0	189.0	550.0	12.8	65.0	.0280	1.00	1.00	
IB0006	MARS	IB0001	698.0	134.0	550.0	13.0	65.0	.0280	1.00	1.00	
IB0007	NOVA 66	IB0001	389.0	155.0	550.0	11.0	65.0	.0280	1.00	1.00	
IB0008	PETA	IB0001	420.0	240.0	550.0	11.3	65.0	.0280	1.00	1.00	
IB0009	STARBONNETT	IB0001	880.0	164.0	550.0	13.0	65.0	.0280	1.00	1.00	
IB0010	UPLRI5	IB0001	620.0	160.0	380.0	11.5	50.0	.0220	0.60	1.00	
IB0011	UPLRI7	IB0001	760.0	150.0	450.0	11.7	65.0	.0280	1.00	1.00	
IB0012	IR 58	IB0001	460.0	5.0	420.0	13.5	60.0	.0250	1.00	1.00	
IB0013	SenTaNi (???)	IB0001	320.0	50.0	550.0	10.0	70.0	.0300	1.00	1.00	
IB0014	IR 54	IB0001	350.0	125.0	520.0	11.5	60.0	.0280	1.00	1.00	
IB0015	IR 64	IB0001	500.0	160.0	450.0	12.0	60.0	.0250	1.00	1.00	
IB0016	IR 60(Est)	IB0001	490.0	100.0	320.0	11.5	75.0	.0275	1.00	1.00	
IB0017	IR 66	IB0001	500.0	50.0	490.0	12.5	62.0	.0265	1.00	1.00	
IB0018	IR 72x	IB0001	400.0	100.0	580.0	12.0	76.0	.0230	1.00	1.00	
IB0019	RD 7 (cal.)	IB0001	603.3	150.0	452.5	11.2	65.0	.0230	1.00	1.00	
IB0020	RD 23 (cal.)	IB0001	310.3	140.0	370.0	11.2	53.0	.0230	1.00	1.00	
IB0021	CICA8	IB0001	700.0	120.0	360.0	11.7	60.0	.0270	1.00	1.00	
IB0022	LOW TEMP.SEN	IB0001	400.0	120.0	420.0	12.0	60.0	.0250	1.00	0.80	
IB0023	LOW TEMP.TOL	IB0001	400.0	120.0	420.0	12.0	60.0	.0250	1.00	1.25	
IB0024	17 BR11, T.AMAN	IB0001	740.0	180.0	400.0	10.5	55.0	.0250	1.00	0.90	
IB0025	18 BR22, T.AMAN	IB0001	650.0	110.0	400.0	12.0	60.0	.0250	1.00	1.00	
IB0026	19 BR 3, T.AMAN	IB0001	650.0	110.0	420.0	12.0	65.0	.0250	1.00	1.00	
IB0027	20 BR 3, BORO	IB0001	650.0	90.0	400.0	13.0	65.0	.0250	1.00	1.00	
IB0029	CPIC8	IB0001	380.0	150.0	300.0	12.8	38.0	.0210	1.00	1.00	
IB0030	LEMONT	IB0001	500.0	50.0	300.0	12.8	60.0	.0207	1.00	1.00	
IB0031	RN12	IB0001	380.0	50.0	300.0	12.8	40.0	.0199	1.00	1.15	
IB0032	TW	IB0001	360.0	50.0	290.0	12.8	55.0	.0210	1.00	1.00	
IB0115	IR 64	IB0001	540.0	160.0	490.0	12.0	50.0	.0250	1.10	1.00	
IB0116	HEAT SENSITIVE	IB0001	460.0	5.0	390.0	13.5	62.0	.0250	1.00	1.15	
IB0118	IR 72	IB0001	560.0	20.0	390.0	13.5	60.0	.0250	1.00	1.00	

TABLE 18. GENETIC COEFFICIENTS FILE FOR CROPSIM-CASSAVA. (CSSIM940.CUL)

*CASSAVA GENOTYPE COEFFICIENTS -CSSTM940 MODEL

!

@VAR#	VRNAME.....	TYPE	DUB1	DUBR	DESP	PHCX	S#PE	S#FX	S#PX	SWNX	L#IS	L#IP	LALX	LAXA	LAL3	LAW5	LFLI
!			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
990001	Default	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0001	MCol-1120	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0002	MCol-22	1	44.4	58.8	0	20.0	1.2	3.60	28	.650	0.85	330	300	60	50	180	130
UC0003	MCl-113	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0004	MMex-59	1	41.3	29.4	0	24.0	1.0	2.80	35	.750	1.21	212	450	60	50	250	65
UC0005	Popayan	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0006	MCol-1684	1	14.7	24.8	0	27.5	1.0	2.61	27	.590	0.94	370	220	55	40	270	45
UC0007	MVen-77	1	49.4	42.9	0	27.5	1.0	2.95	25	.760	1.13	353	450	70	35	270	75
UC0008	MPtr-26	1	64.7	50.0	0	27.5	1.0	3.00	20	.708	1.45	294	450	70	50	220	75
UC0009	MCol-638	1	44.4	28.2	0	23.5	1.0	2.95	52	.700	1.10	235	350	60	35	220	80
UC0010	Ceiba	1	32.4	35.3	0	26.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0011	JD2	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0012	MAus-1	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0013	MAus-10	1	14.7	41.2	0.25	25.0	3.0	3.09	50	0.76	1.21	235	240	45	70	350	161
UC0014	MAus-13	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0014	MAus-15	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0016	MAus-19	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0017	MAus-22	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0018	MAus-7	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0019	MAus-8	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0020	MCol-1438	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0021	MCol-1468	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0022	MCol-1501	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0023	MCol-1505	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0024	MCol-1513	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0025	MCol-72	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0026	MMex-11	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0027	TMS-30572	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0028	Nina	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0029	Pata	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0030	SM1-150	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0031	Betawi	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70
UC0032	CM-507-37	1	44.1	35.3	0	27.5	1.0	3.00	30	.650	1.21	235	300	60	50	240	70

! Notes:

! Palta (1984): MMex59, MVen218, MCol1684 are vigorous cultivars;

! MCol72,MCol22,MCol638 are less vigorous.

! CM507-37: hybrid; see El-Sharkaway & Cock (1987).

! TMS 30572 in Gutierrez et al (1987).

APPENDIX B.

IMPLEMENTING PEST DAMAGE

In DSSAT v3, the pest damage routines have been implemented only in the CROPGRO models (Batchelor et al., 1993). In order to use the damage routines, the type of damage, as well as the amount of damage, must be input by the user. The damage routines were structured to provide flexibility in collecting damage data. Two different methods can be used to describe damage. In typical farm operations, pest population data can be collected through field scouting, and damage can be computed if pest feeding rates are known. In other instances, the actual amount of damage can be measured. This latter approach is useful when pest populations are difficult to measure, or when the source of damage is unknown. Predefined pest definitions can be used to convert scouting report data on pest populations, or observed damage, into daily damage, which is subsequently applied to the crop model. Predefined damage definitions can be used to convert observed levels of damage into daily damage that is subsequently applied to the crop model. New pest or damage definitions can be developed for a wide range of damage types. Currently, damage can be applied to 21 different plant components in CROPGRO.

PEST DAMAGE METHODOLOGY

Twenty one state and/or rate variables, called coupling point (see Table 19), were identified as targets for pest damage. Damage is applied to each coupling point by the coupling point damage variable (or PCPID, described in the following section). There is a unique coupling point damage variable for each coupling point. The user supplies information that is used by the crop model to compute daily damage, which is then applied to the desired coupling point through the coupling point damage variable.

Four different types (or variable PCTID, described in the following section) can be defined to describe observed damage data:

1. Daily Absolute Damage rate,
2. Percent Observed Damage,
3. Daily Percent Damage rate, and
4. Daily Absolute Damage rate with pest competition and food preference effects.

Table 19 shows the allowable damage types available for each coupling point. The coupling point damage variable (PCPID) contains the amount of damage

TABLE 19. COUPLING POINTS AND DAMAGE TYPES USED TO APPLY DAMAGE IN THE CROPGRO CROP MODELS.

Coupling point	Units ¹	Available damage types ²	Coupling point damage variable
leaf area index	m ² m ⁻²	1, 2, 3, 4	LAD
leaf mass	g m ⁻²	1, 2, 3, 4	LMD
stem mass	g m ⁻²	1, 2, 3, 4	SMD
root mass	g m ⁻²	1, 3, 4	RMD
root length	cm cm ⁻²	1, 3, 4	RLF
root length volume	cm cm ⁻³	1, 3, 4	RLV
small seed number	no. m ⁻²	1, 3, 4	SDNS
large seed number	no. m ⁻²	1, 3, 4	SDNL
mature seed number	no. m ⁻²	1, 3, 4	SDNM
small seed mass	g m ⁻²	1, 3, 4	SDMS
large seed mass	g m ⁻²	1, 3, 4	SDML
mature seed mass	g m ⁻²	1, 3, 4	SDMM
small shell number	no. m ⁻²	1, 3, 4	SHNS
large shell number	no. m ⁻²	1, 3, 4	SHNL
mature shell number	no. m ⁻²	1, 3, 4	SHNM
small shell mass	g m ⁻²	1, 3, 4	SHMS
large shell mass	g m ⁻²	1, 3, 4	SHML
mature shell mass	g m ⁻²	1, 3, 4	SHMM
whole plant	no m ⁻²	1, 3	WPD
assimilate	g m ⁻²	1, 3	ASM
necrotic leaf area index	cm ² cm ⁻²	1, 3	PDLA

¹ Per unit ground area

² Where damage type are: (1) Daily Absolute Damage rate, (2) Percent Observed Damage, (3) Daily Percent Damage rate, and (4) Daily Absolute Damage rate with pest competition and food preference effects

(PDCF1) and the damage type descriptor (PCTID) tells CROPGRO how to apply the damage to the coupling point.

The type of damage selected depends upon the type of damage data that can be collected. Number 1, "Absolute Daily Damage," is useful when pest population data can be collected. If pest populations and feeding rates are known, daily damage to coupling points can be computed in units of mass per unit area.

Number 2, “Percent Observed Damage,” typically occurs when observations of plant components are compared between some scientific treatment and control. For example, defoliation can occur in one treatment, resulting in a percent difference in leaf mass between a treatment and control. In this case, the source of

The following columns are included in these pest coefficient files.

- 1st column: pest number (LN);
- 2nd column: pest identifier (PID);
- 3rd column: pest name (PNAME);
- 4th column: damage characterization type (PCTID);
- 5th column: coupling point identifier (PCPID), defined in Table 19;
- 6th column: feeding rate coefficient (PDCF1);
- 7th column: additional coefficient (PDCF2, currently not implemented.
- 8th column: units of the feeding rate coefficient (Units); and
- 9th column: source for damage rates (Source).

To add a new pest or damage type to the pest coefficient file, the user must contact the model developer (see Appendix D of this Part).

TABLE 20. TYPICAL TIME SERIES FILE (FILET) CONTAINING EXAMPLES OF PEST PROGRESS DATA FOR SIX PEST AND DAMAGE TYPES¹ FOR SOYBEAN.

*EXP.DATA (T): UFBI9101SB Drew field drought study

@TRNO	DATE	CEW6	SL6	VC5	VC6	SHAD	GC5
1	91147	0.0	1.5	0.25	0.4	30.0	0.0
1	91154	0.5	2.8	0.25	0.6	30.0	0.6
1	91161	0.9	3.3	0.1	1.2	0.0	0.1
1	91168	1.5	6.4	0.0	1.6	-99	0.0
1	91175	0.2	0.5	0.0	1.8	-99	0.0
1	91181	0.0	1.2	0.0	1.0	-99	0.0
1	91188	-99	1.5	-99	0.2	-99	0.0
1	91195	-99	3.3	-99	0.0	-99	0.0

¹ The pest names defined by these pest header are: CEW6 - 6th instar corn ear-worm; SL6 - 6th instar soybean looper; VC5- 5th instar velvetbean caterpillar; VC6 - 6th instar velvetbean caterpillar; SHAD - percent canopy shading by shade cloth; and GC5 - 5th instar green cloverworm. Each pest and damage is defined in the pest coefficient file.

TABLE 25. TIME SERIES FILE FOR THE SOYBEAN EXPERIMENT UFGA7802 SHOWING 6TH INSTAR CORN EARWORM POPULATION LEVELS (CEW6).

*EXP.DATA (T): UFGA7802SB BRAGG, IRR*INSECT DAMAGE

@TRNO	DATE	LAID	SWAD	GWAD	LWAD	CWAD	PWAD	SHAD	SH%D	SLAD	HIAD	CEW6
1	78194	.89	178	0.	266	444	0.	0.	0.00	334.6	0.0	0.0
1	78201	1.28	300	0.	366	667	0.	0.	0.00	349.7	0.0	0.0
1	78208	1.91	551	0.	656	1207	0.	0.	0.00	291.2	0.0	0.0
1	78215	2.86	943	0.	843	1786	0.	0.	0.00	339.3	0.0	0.0
1	78222	4.17	1561	0.	1187	2748	0.	0.	0.00	351.3	0.0	0.0
1	78229	3.90	1956	0.	1204	3160	0.	0.	0.00	323.9	0.0	0.0
1	78236	4.66	2947	0.	1723	4792	123	123	0.00	270.5	0.0	0.0
1	78243	4.47	3144	0.	1772	5224	308	308	0.00	252.3	0.0	0.0
1	78250	4.44	3303	182	1631	5740	805	623	22.60	272.2	0.030	0.0
1	78257	3.99	3326	754	1568	6507	1613	859	46.75	254.5	0.116	0.0
1	78264	4.67	3657	1912	1769	8586	3161	1249	60.49	264.0	0.222	0.0
1	78271	2.83	2732	2223	1180	7144	3232	1009	68.78	239.8	0.311	0.0
1	78278	2.09	2515	2730	858.0	7136	3763	1033	72.55	243.6	0.383	0.0
1	78285	.47	1851	2913	170.0	5866	3845	932	75.76	276.5	0.497	0.0
1	78292	.09	2064	3169	34.0	6270	4172	1003	75.96	264.7	0.505	0.0
2	78194	.75	160	0.	244	405	0.	0.	0.00	307.4	0.0	0.0
2	78201	1.08	251	0.	311	563	0.	0.	0.00	347.3	0.0	0.0
2	78208	1.81	535	0.	626	1161	0.	0.	0.00	289.1	0.0	0.0
2	78215	3.29	1080	0.	974	2054	0.	0.	0.00	337.8	0.0	0.0
2	78222	4.38	1663	0.	1261	2923	0.	0.	0.00	347.3	0.0	0.0
2	78229	4.30	2083	0.	1392	3475	0.	0.	0.00	308.9	0.0	0.0
2	78236	4.21	2556	0.	1517	4184	112	112	0.00	277.5	0.0	0.0
2	78243	4.50	2673	0.	1439	4431	319	319	0.00	312.7	0.0	0.0
2	78250	2.09	1998	42	838	3104	268	226	15.67	249.4	0.014	0.0
2	78257	3.24	2650	253	1220	4530	661	408	38.28	265.6	0.056	0.0
2	78264	2.30	2609	471	931	4440	901	430	52.28	247.0	0.106	0.0
2	78271	1.14	2113	775	498	3812	1200	425	64.58	228.9	0.203	0.0
2	78278	.85	1905	782	371	3398	1122	340	69.70	229.1	0.230	0.0
2	78285	.53	1922	1149	236	3732	1574	425	73.00	224.5	0.308	0.0
2	78292	.07	1590	1206	30	3250	1630	424	73.99	233.3	0.371	0.0
3	78194	.89	178	0.	266	444	0.	0.	0.00	334.6	0.0	0.0
3	78201	1.28	300	0.	366	667	0.	0.	0.00	349.7	0.0	0.0
3	78208	1.91	551	0.	656	1207	0.	0.	0.00	291.2	0.0	0.0
3	78215	2.86	943	0.	843	1786	0.	0.	0.00	339.3	0.0	0.0
3	78222	4.17	1561	0.	1187	2748	0.	0.	0.00	351.3	0.0	0.0
3	78229	3.90	1956	0.	1204	3160	0.	0.	0.00	323.9	0.0	0.5
3	78236	4.66	2947	0.	1723	4792	123	123	0.00	270.5	0.0	1.0
3	78243	4.47	3144	0.	1772	5224	308	308	0.00	252.3	0.0	2.5
3	78250	4.44	3303	182	1631	5740	805	623	22.60	272.2	0.030	5.5
3	78257	3.99	3326	754	1568	6507	1613	859	46.75	254.5	0.116	11.1
3	78264	4.67	3657	1912	1769	8586	3161	1249	60.49	264.0	0.222	14.1
3	78271	2.83	2732	2223	1180	7144	3232	1009	68.78	239.8	0.311	13.1
3	78278	2.09	2515	2730	858	7136	3763	1033	72.55	243.6	0.383	0.5
3	78285	.47	1851	2913	170	5866	3845	932	75.76	276.5	0.497	0.8
3	78292	.09	2064	3169	34	6270	4172	1003	75.96	264.7	0.505	0.9

TABLE 26. SIMULATION CONTROL SECTION OF FILE UFGA7802.SBX SHOWING THE DISEASE SIMULATION OPTION (DISES) SET TO 'Y' TO ENABLE PEST DAMAGE SIMULATION.

GENERAL		NYERS	NREPS	START	YRDAY	RSEED	SNAME.....					
1	GE	1	1	S	78166	2150	BRAGG, IRRIGATED & NON-IR					
OPTIONS		WATER	NITRO	SYMBI	PHOSP	POTAS	DISES					
1	OP	Y	Y	Y	N	N	Y					
METHODS		WTHR	INCON	LIGHT	EVAPO	INFIL	PHOTO					
1	ME	M	M	E	R	S	C					
MANAGEMENT		PLANT	IRRIG	FERTI	RESID	HARVS						
1	MA	R	R	R	R	M						
OUTPUTS		FNAME	OVVEW	SUMRY	FROPT	GROUT	CAOUT	WAOUT	NIOUT	MIOUT	DIOUT	LONG
1	OU	N	Y	Y	3	Y	Y	Y	Y	N	Y	

damage recorded in FILET will be directly applied to one or more variables in the model. This means that these variables in the model are proportionally reduced by the same percent as entered for these coefficients in FILET. When a damage type, such as this one, is defined, direct measures of damage are typically recorded in the time series file and the damage coefficient is set to 1.0.

A column with the header PCLA was entered in the time series file UFQU7902.SBT. Percent damage on each observation date was entered for treatment 2 as shown in Table 28. The crop model linearly interpolates between observations to obtain daily levels of observed damage. An entry of “-99” indicates that data were not available. Thus, CROPGRO skips that entry for linear interpolation of daily damage. Finally, the DISES variable in the Simulation Controls section of UFQU7902.SBX was set to ‘Y’ as shown in Table 26.

TABLE 28. TIME SERIES DATA FILE FOR THE SOYBEAN EXPERIMENT UFQU7902 SHOWING OBSERVED DEFOLIATION LEVELS (PCLA) RESULTING FROM VELVETBEAN CATERPILLAR DAMAGE.

*EXP.DATA (T): UFQU7902SB BRAGG, WELL IRRIGATED (defoliation)

@TRNO	DATE	LAID	SWAD	GWAD	LWAD	CWAD	PWAD	SHAD	SH%D	SLAD	PCLA
1	79234	4.15	1945	0	1214	3228	0	0	0.00	323.5	-99
1	79241	5.48	2650	0	1659	4455	132	132	0.00	327.6	-99
1	79248	5.53	3075	60	1925	5491	566	506	10.60	298.8	-99
1	79255	5.54	3509	303	1718	6755	1357	1054	15.24	293.4	-99
1	79262	5.32	3435	777	1866	7395	1988	1211	39.08	269.8	-99
1	79271	4.04	3362	1319	1481	7351	2509	1190	48.59	272.4	-99
1	79276	4.25	3103	1943	1540	7635	3013	1070	64.49	279.8	-99
1	79283	3.92	3754	2635	1659	9372	4039	1404	65.24	248.3	-99
1	79288	3.85	3601	3313	1600	9957	4883	1570	67.85	261.2	-99
1	79292	1.36	2633	3039	592	7578	4267	1228	71.22	200.6	-99
1	79295	0.54	2084	3896	148	7666	5406	1510	72.07	243.2	-99
1	79303	0.47	2388	3541	140	7345	4763	1222	74.34	241.0	-99
2	79234	5.00	-99	0	1540	-99	0.	-99	-99	-99	0.0
2	79241	5.20	-99	0	1540	-99	100	-99	-99	-99	0.0
2	79248	4.10	-99	0	1600	-99	600	-99	-99	-99	22.6
2	79255	2.50	-99	300	1096	-99	1200	-99	-99	-99	56.1
2	79262	2.70	-99	700	1185	-99	1800	-99	-99	-99	50.0
2	79271	1.90	-99	1000	859	-99	1950	-99	-99	-99	52.5
2	79276	1.80	-99	1600	948	-99	2500	-99	-99	-99	57.1
2	79283	1.50	-99	2100	740	-99	3200	-99	-99	-99	57.9
2	79288	1.30	-99	2300	592	-99	3600	-99	-99	-99	65.7
2	79292	0.70	-99	2400	266	-99	3400	-99	-99	-99	75.3
2	79295	0.20	-99	3000	88	-99	4200	-99	-99	-99	85.4
2	79303	0.00	-99	-99	0.	-99	-99	-99	-99	-99	100.0
2	79304	0.00	-99	-99	0.	-99	-99	-99	-99	-99	100.0
2	79305	0.00	-99	-99	0.	-99	-99	-99	-99	-99	100.0

After the two damage types were confirmed defined in the pest coefficient file (PNGRO940.PST; Table 22), the observed levels of damage were input in the time series file, UFGA8602.PNT, in columns corresponding to the four character pest identification codes PCLA and PDLA (Table 30). Daily values of damage will be generated by the model through linearly interpolating between observations. Finally, the DISES variable in the Simulation Controls section of UFGA8602.PNX was set to 'Y' to simulate pest damage in the same manner as shown in Table 26.

RUNNING UNDER THE DSSAT v3 SHELL

When running the models under the DSSAT v3 Shell (see Volume 1-3, Hunt et al. 1994, of this book, for a description of the Shell), the location of the various files are obtained from a file-locator file in the DSSAT v3 directory named DSSAT-PRO.FLE (see the Appendix to Volume 1 for a listing of this file). Each crop model is designed to first check the local directory (from where the model is run) for input files. If it does not find them in the local path, the model modules will open the DSSATPRO.FLE file to find the path of soil, weather, and crop coefficient files. Table 31 lists the various modules and files required for running the crop models and the default paths for running them under DSSAT the DSSAT v3 Shell. Note, however, that DSSAT v3 users can change these paths through the SETUP menu found under the DSSATv3 Shell (Volume 1-3, Hunt et al. 1994).

TABLE 31. SUGGESTED ORGANIZATION OF FILES FOR EXECUTION OF CROP MODELS UNDER THE DSSAT v3 SHELL, USING CROPGRO-SOYBEAN AS AN EXAMPLE.

Path	Module or File Type	File Name
C:\DSSAT3	Model Driver Module	MDRIV940.EXE
C:\DSSAT3	Model Input Module	MINPT940.EXE
C:\DSSAT3	Model Executable Module	CRGR0940.EXE
C:\DSSAT3	Graphic Program	WINGRAF.EXE
C:\DSSAT3	Variable Definition File	DATA.CDE
C:\DSSAT3	File Containing Paths	DSSATPRO.FLE
C:\DSSAT3\GENOTYPE	Crop Cultivar Coefficient File	SBGR0940.CUL
C:\DSSAT3\GENOTYPE	Crop Species Coefficient File	SBGR0940.SPE
C:\DSSAT3\GENOTYPE	Crop Ecotype Coefficient File	SBGR0940.ECO
C:\DSSAT3\SOIL	Soil Data File	SOIL.SOL
C:\DSSAT3\WEATHER	Weather Data Files	UFGA7801.WTH
C:\DSSAT3\SOYBEAN	Management Inputs (FILEXs)	UFGA7801.SBX
C:\DSSAT3\SOYBEAN	Observed Field Data (Averages)	UFGA7801.SBA
C:\DSSAT3\SOYBEAN	Observed Field Data (Seasonal)	UFGA7801.SBT
C:\DSSAT3\SOYBEAN	List of Experiments	EXP.LST
C:\DSSAT3\SOYBEAN	List of Available Weather Data	WTH.LST
C:\DSSAT3\SOYBEAN	Model Output Files	GROWTH.OUT, etc.

RUNNING AS STAND-ALONE EXECUTABLES

When running the DSSAT v3 crop models in stand-alone mode, all input and output data files are stored in one directory on a disk, and the executable modules are stored in a separate disk directory. One could also combine all executables with the input and output data. Table 32 lists the different files needed to run the crop models in a stand-alone mode and a suggested path structure. The example files are listed for soybean using the CROPGRO module, however a similar structure could be used for other models.

TABLE 32. SUGGESTED ORGANIZATION OF FILES FOR STAND-ALONE EXECUTION OF CROP MODELS, USING CROPGRO-SOYBEAN AS AN EXAMPLE.

Path	Module or File Type	File Name
C:\CROPGRO	Model Driver Module	MDRIV940.EXE
C:\CROPGRO	Model Input Module	MINPT940.EXE
C:\CROPGRO	Model Executable Module	CRGR0940.EXE
C:\CROPGRO	Graphic Program	WINGRAF.EXE
C:\CROPGRO	Variable Definition File	DATA.CDE
C:\CROPGRO	Batch File to Run Crop Model	GRO.BAT
C:\CROPGRO	Batch File to Run Graphics	GRAPH.BAT
C:\CROPGRO\SOYBEAN	Soil Data File	SOIL.SOL
C:\CROPGRO\SOYBEAN	Weather Data Files	UFGA7801.WTH
C:\CROPGRO\SOYBEAN	Management Inputs (FILEXs)	UFGA7801.SBX
C:\CROPGRO\SOYBEAN	Observed Field Data (Averages)	UFGA7801.SBA
C:\CROPGRO\SOYBEAN	Observed Field Data (Seasonal)	UFGA7801.SBT
C:\CROPGRO\SOYBEAN	List of Experiments	EXP.LST
C:\CROPGRO\SOYBEAN	List of Available Weather Data	WTH.LST
C:\CROPGRO\SOYBEAN	Crop Cultivar Coefficient File	SBGR0940.CUL
C:\CROPGRO\SOYBEAN	Crop Species Coefficient File	SBGR0940.SPE
C:\CROPGRO\SOYBEAN	Crop Ecotype Coefficient File	SBGR0940.ECO
C:\CROPGRO\SOYBEAN	Model Output Files	GROWTH.OUT, etc.

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GRAPHING
SIMULATED &
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DATA

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CHAPTER ONE.

INTRODUCTION

A graphics program was written for DSSAT v3 to provide users with the capability to easily plot graphs that are routinely used during the development and validation of crop models. This program, called Graphing Simulated and Experiment Data, or Wingraf, adheres to the file definitions and data formats of DSSAT v3 described in Volume 2-1 (Jones et.al 1994) of this book. It is similar in operation to the graphics package in DSSAT v2.1 (IBSNAT 1989), but with notable functional and operational differences. Functionally, it allows users to plot time series graphs, Y versus X graphs, (such as grain weight vs. biomass), end of season responses (such as yield vs. irrigation amount), and observed vs. simulation crop performance relationships for validation purposes. Operationally, users can use a mouse or keyboard commands to select variables. They can print the graph or save it to a file, change screen colors and graph scales, and create combinations of graphs that were not possible in v2.1.

The basic design of Wingraf is based on a set of codes that are used as headers over each column of data. For example, a simulated results data file may have a column of data with a header LAID, which refers to time-course values of leaf area index (LAI). If there is a corresponding field observation data file, the Wingraf program will search that file for a column of data with LAID as a header. It will then display a plot of LAI vs. time, with simulated data graphed by connecting points and observed data plotted by symbols. If the program does not find LAID in the observed data file, it will just plot simulated results. It can also be used to plot experimental data only.

A set of codes for crop, soil, and weather data are included with DSSAT v3 (see Appendix C of Volume 2-1, Jones et al. 1994, of this book for a listing of these codes). Note that these codes (left column) are followed by a short description which is used to label graphs, and a longer description with units. These codes are not rigid. Users may add their own codes and definitions to the file named DATA.CDE (see Appendix C of Volume 2-1, Jones et al. 1994, of this book), and Wingraf will correctly label any data that has this new code as a header. Note, however, that the DSSAT v3 crop models use the codes as defined in Appendix C of Volume 2-1 (Jones et al. 1994) of this book. If other crop models use other codes, this file could be changed accordingly.

CHAPTER TWO.

PROGRAM OVERVIEW

GUIDELINES

GENERAL

Wingraf was developed to run under the DSSAT v3 Shell (see Volume 1-3, Hunt et al. 1994, of this book) or as a stand-alone program (see note below). It uses TurboVision¹ for the user interface routines. The user interfaces with the program via menus and dialog boxes and the program displays information via windows. Wingraf supports the use of a mouse, provided a mouse driver has been loaded prior to the execution of this program. Both mouse and keyboard commands can be used in Wingraf, but the user interface is most easily exploited by the use of the mouse, and as such, examples cited in this Part refer to mouse actions. If using a keyboard, however, nearly all menu choices may be selected by use of the <ALT> key as well as with the highlighted letter of the menu option. The <TAB> and <SHIFT><TAB> keys can be used for moving through choices in dialog boxes.

***NOTE:** When running Wingraf as a stand-alone program, the options to execute the program are as follows:*

1. *If running Wingraf under the Wingraf program directory, type "WINGRAF".*
2. *If running Wingraf under the data file directory, type "\DSSAT3\WINGRAF" at the DOS System C> prompt.*
3. *If the Wingraf program directory is included in the system's PATH, type "WINGRAF" at the DOS System C> prompt.*

SCREEN "BUTTONS"

In all Wingraf screens, where multiple buttons are available (e.g., the OK button in Screen 1, on following page, or the PREVIOUS, NEXT, X VARIABLE, GRAPH, RESET, OPTION buttons in Screen 3 in Chapter 3), you may "press" these by one of two methods:

- 1) If using a mouse, click on the button.
- 2) If using the keyboard, highlight the button using the <TAB> and <SHIFT><TAB> keys and then press the <ENTER> key.

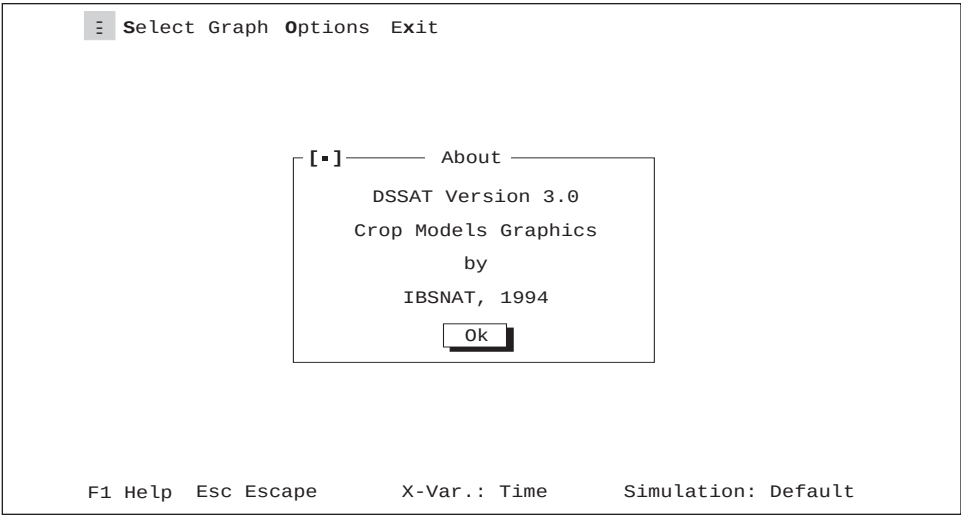
¹ TurboVision is a registered trademark of Borland International, Inc.

MENU STRUCTURE

The Wingraf main menu options are selected by a single click with a mouse on a menu choice, which will either execute an action, present a submenu, or display a dialog box requiring further user input. From the keyboard, use the arrow keys to move through and highlight the main menu items. Press the <ENTER> key when the menu item you wish to open is highlighted.

Selecting the “]” symbol in the upper left corner of the Wingraf main menu display, allows you to exit Wingraf, or alternatively, to display the “About” screen (Screen 1, below).

A context-sensitive help function is provided throughout the entire program. The <F1> key invokes the help system.



SCREEN1

HARDWARE

Wingraf requires a minimum configuration of a 286SX or better processor running EMM386 with expanded memory with a math-coprocessor. DOS version 5.0 or higher is recommended. Wingraf requires 640K of random access memory (RAM), with a minimum of 420K free RAM running under the DSSAT v3 Shell. Wingraf supports most text and graphics display modes, but VGA color is recommended for clarity. In addition, if hardcopy output is needed, a supported printer is required.

CHAPTER THREE.

EXECUTE PROGRAM

Wingraf can be accessed through the DSSAT v3 Shell under three different entry points. To display graphs of measurements made within the growing season (time series graphs) and summary responses, open the Wingraf program under the Shell's DATA main menu item. To do this, highlight DATA and then select the "X Experiment" option by using the mouse, pressing the <X> key or by moving the highlight bar with the arrow keys to the "X Experiment" option and pressing the <ENTER> key. From the "X Experiment" menu, select the "Utilities" option. A list of three menu options will be presented. Select the "G Graph" menu option and then select a crop from the window that is presented. The Wingraf main menu screen will be presented (see Screen 2 in Chapter 4).

To plot simulated and experimental data, open Wingraf under the Shell's MODEL main menu item. Please note that you must first run one of the DSSAT v3 crop models listed under the MODEL menu item before using the Wingraf program or no simulated data will be available for graphing.

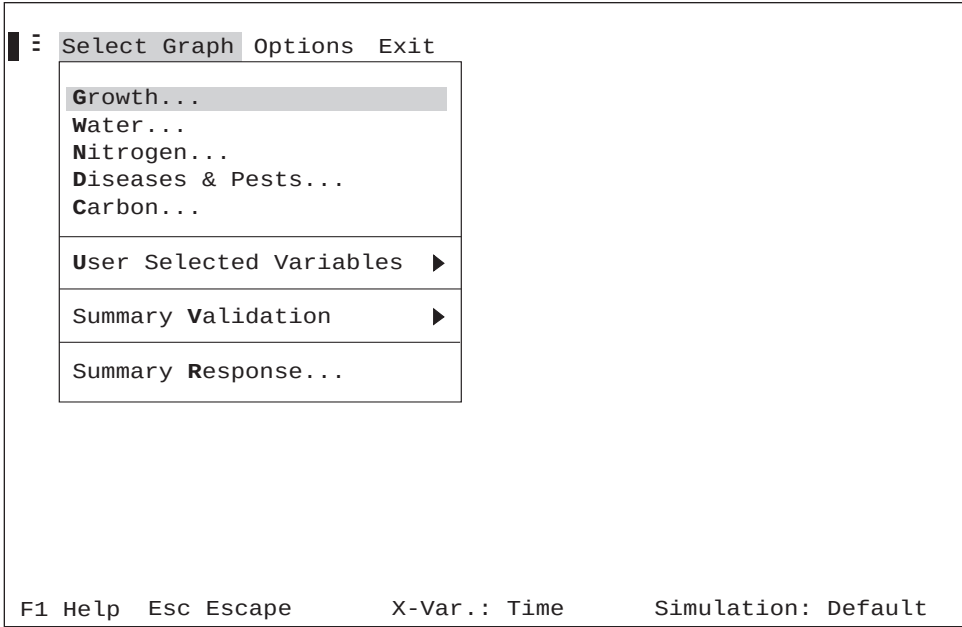
Wingraf is found in two places under the MODEL main menu item. The first can be found by selecting the "O Other" item from the list of options in the pull-down MODEL menu. Select this item and a submenu of various options is presented, including "G Graph." Select "G Graph" to open Wingraf. Alternatively, after selecting one of the crop models in the MODEL pull-down menu, a third tier menu is presented, which includes "G Graph." Again, select "G Graph" to open Wingraf.

When "G Graph" is selected from these selection points, the Wingraf main menu screen is presented (see Screen 2 in Chapter 4). The top line of this screen, with SELECT GRAPH, OPTIONS and EXIT, is the menu bar. Each item in this menu bar has a related pull-down menu. To access these menus, click on the menu item with the mouse and the pull-down menus will be presented. With the keyboard, use the arrow keys to move through the menu bar and the pull-down menus under each will be presented. To select items in these menus, either click on one with the mouse, use the arrow keys to highlight an item in the pull-down menu and press the <ENTER> key or press the first letter of the item. For example, press <G> to open "Growth" under the Select Graph menu bar item.

CHAPTER FOUR.

GRAPH MENU

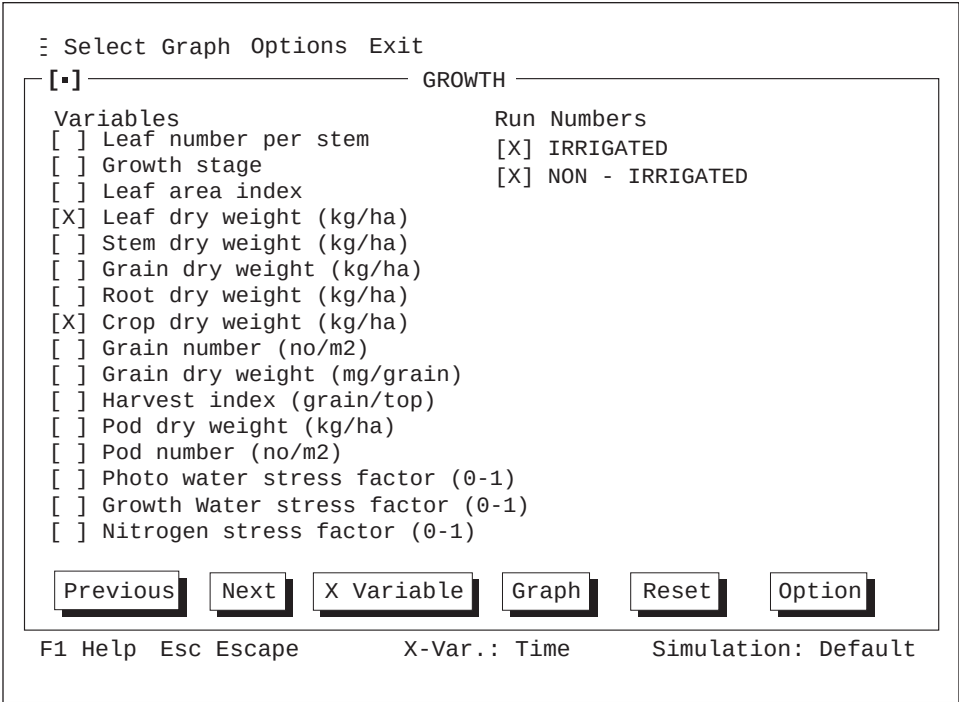
Under the SELECT GRAPH menu item are displayed the primary plotting functions in Wingraf (Screen 2, below). Growth, water, nitrogen, diseases and pests, and carbon output files are directly supported and use the DSSAT v3 standard output files, GROWTH.OUT, WATER.OUT, NITROGEN.OUT, PEST.OUT, and CARBON.OUT, respectively. The phosphorus option is included for compatibility with future model outputs.



SCREEN 2.

GROWTH, WATER, NITROGEN, PHOSPHORUS, DISEASES & PESTS, CARBON OPTIONS

Selecting one of these options enables the user to plot a graph for the selected function. The screens presented when any one of these options is selected are similar. Thus, the screens for “Growth” will be used for illustration. When the “Growth” option is selected, Screen 3, on the following page, is presented.



SCREEN 3.

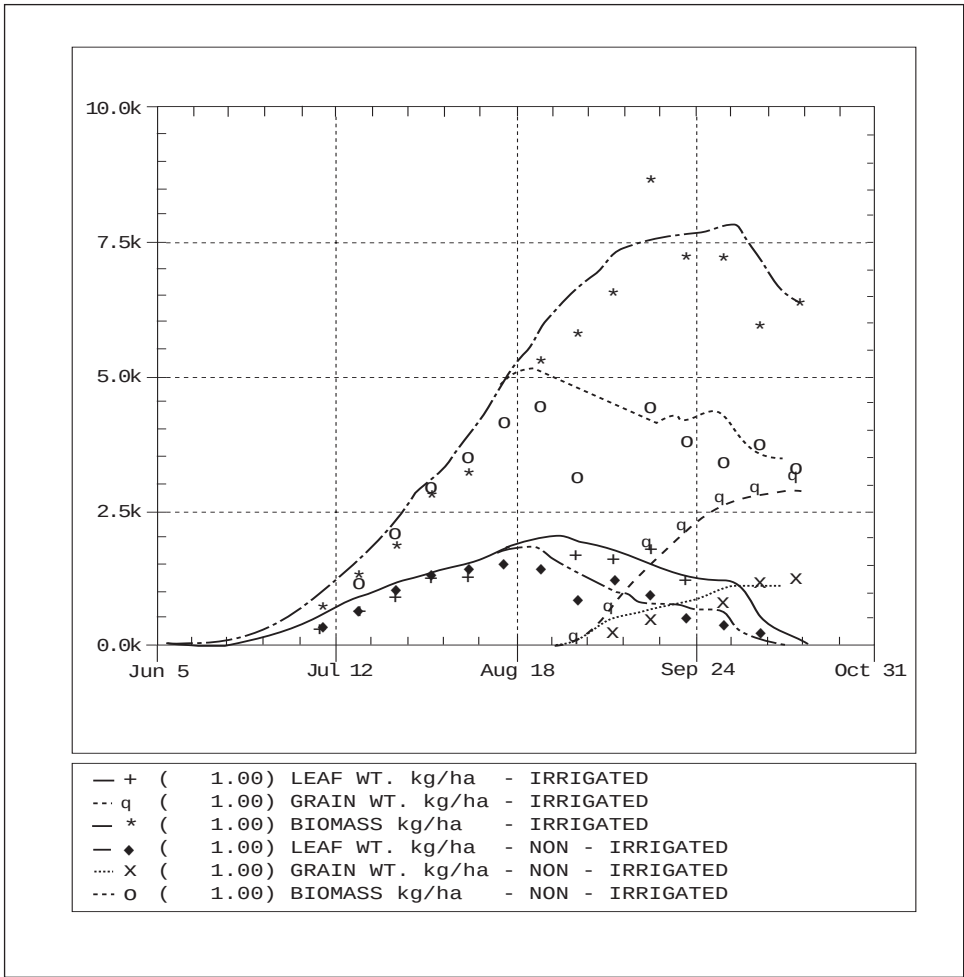
SELECTING PLOTS

In Screen 3, users may select up to 6 plots for each graph. These six plots may be one variable with six runs, six variables with one run, or any combination of variables and runs up to 6. Selecting the RESET button will reset all current selections.

In example Screen 3, two variables, “Leaf dry weight (kg/ha)” and “Crop dry weight (kg/ha),” have been selected and two runs, “IRRIGATED” and “NON-IRRIGATED.”

Pressing the GRAPH button displays the graph of these variables and runs (see Screen 4, on following page).

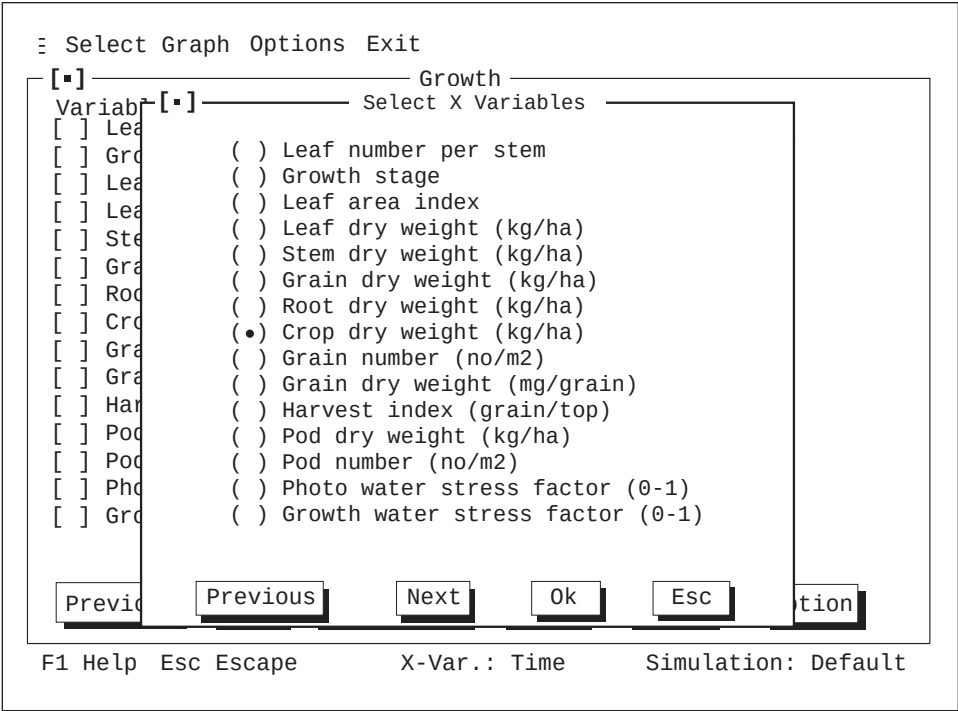
NOTE: The OPTION button on the status line in Screen 3 is grayed out and will not be selectable until the first graph has been plotted.



SCREEN 4.

X-VARIABLE

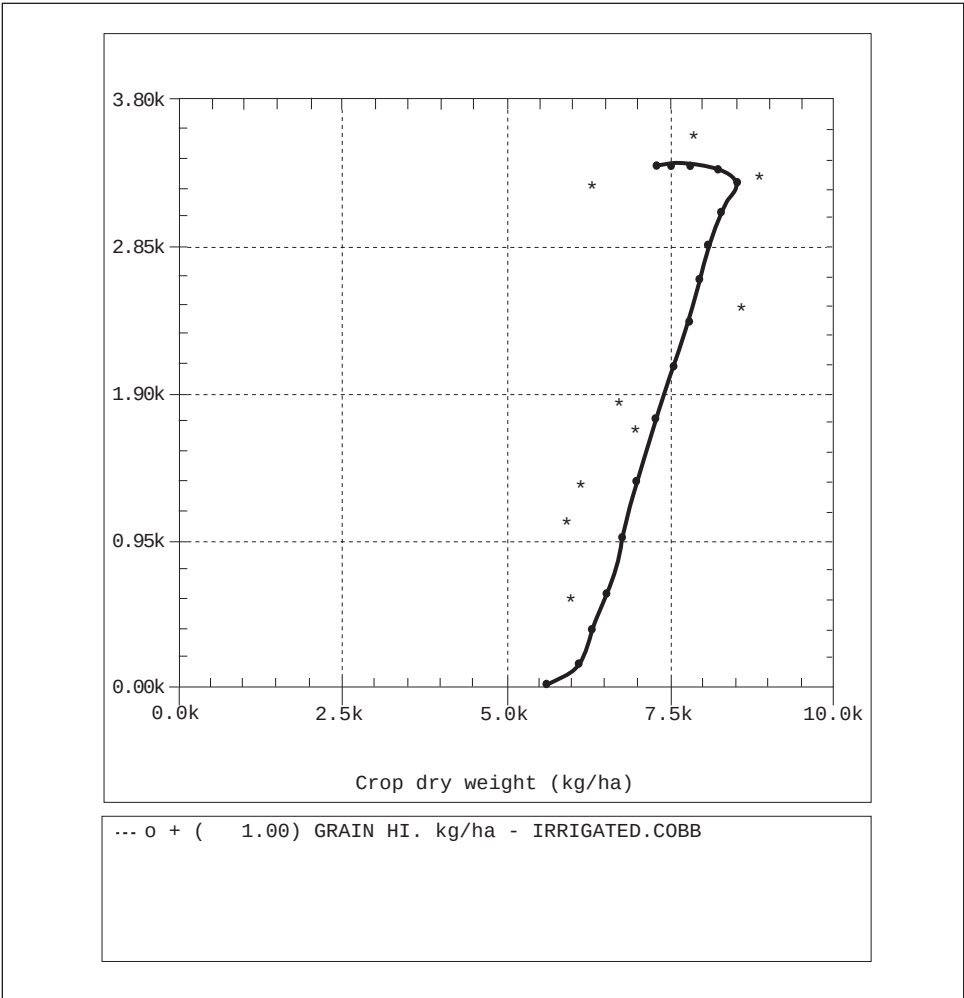
The default setting for graph plotting is the variables selected (for example, those selected in Screen 3) versus time. Users can specify an X-variable other than “time” by pressing the X VARIABLE button (see Screen 3). Screen 5, on the following page, will be presented.



SCREEN 5.

In Screen 5, the X-variable, “Crop dry weight,” has been selected. Pressing the OK button in this screen, will display this variable next to “X-Var:” on the status line in Screen 3. Pressing the GRAPH button in Screen 3 will display this case of Y vs X, as shown in Screen 6, on the following page.

To reset the X variable back to time, select the X VARIABLE button again and press the <ESC> key.



SCREEN 6.

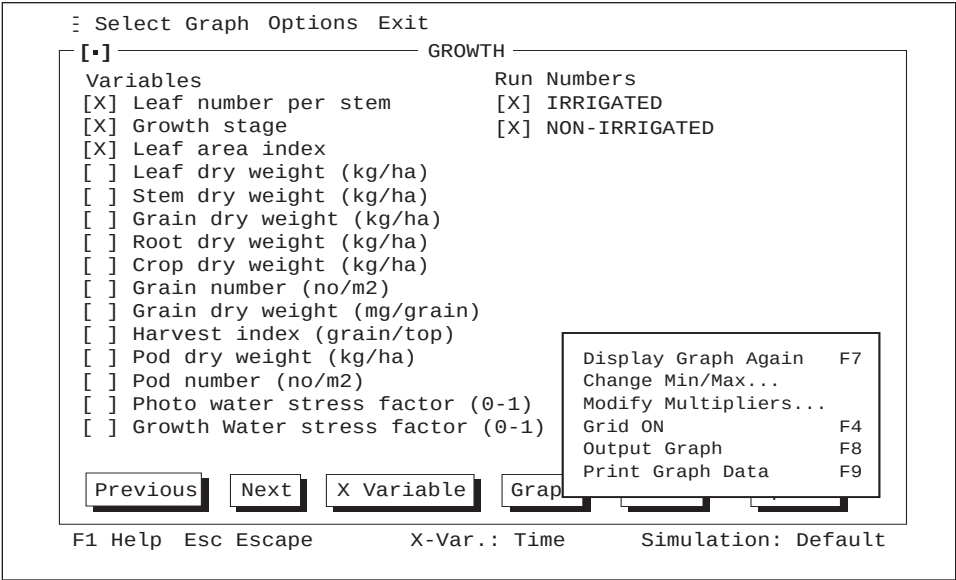
OPTION “BUTTON”

Once a graph has been plotted for selected variables, the OPTION button on the status line (see Screen 3) will no longer be grayed out and will be selectable.

Functions under the OPTION button (see Screen 7, on following page) allow a user to make necessary modifications to the current graph.

“Display Graph Again” will display the modified graph again.

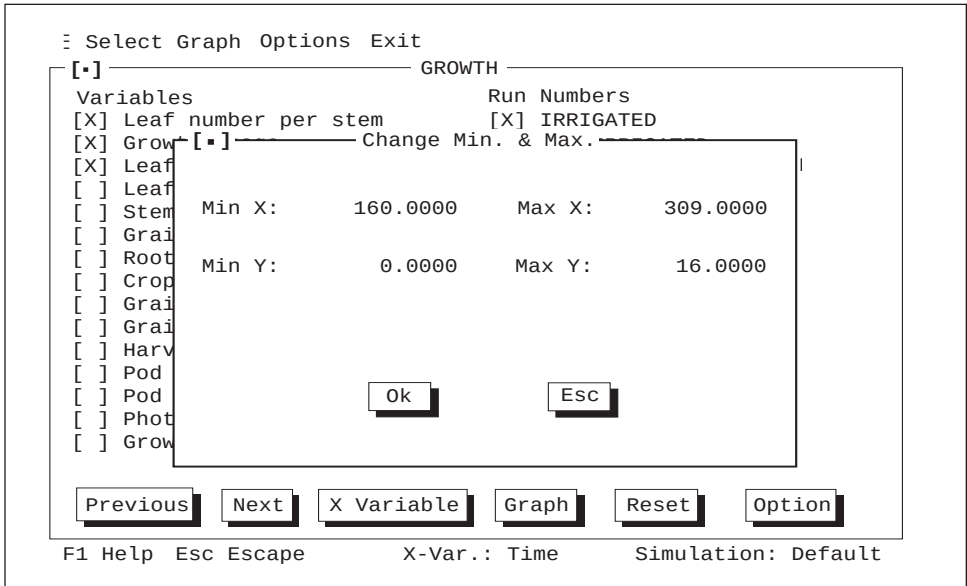
“Change Min/Max” allows the parameters for the X and Y axes to be changed (see Screen 8, on following page).



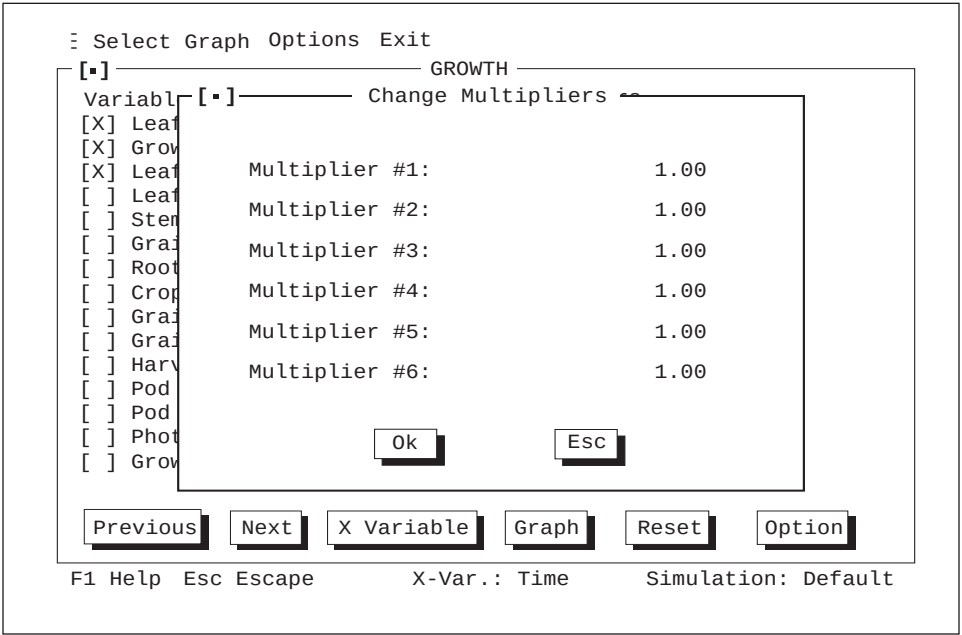
SCREEN 7.

“Modify Multipliers” allows the user to modify the default multiplication factor for each plot (see Screen 9, on following page). Altering multipliers allows variables of widely disparate scaling to be shown on the same graph.

“Grid ON” toggles the plotting of grid lines On/Off.

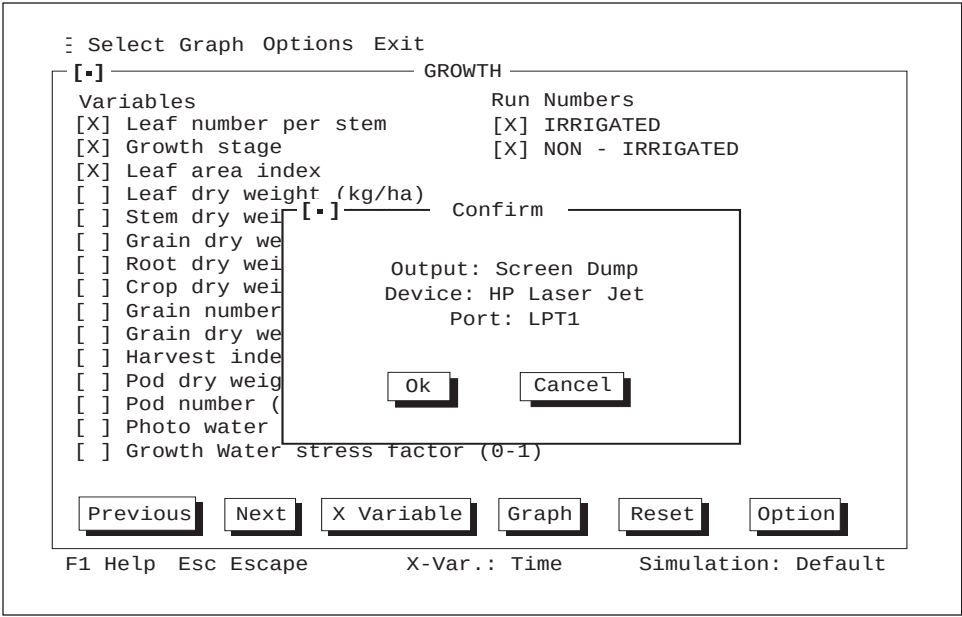


SCREEN 8.



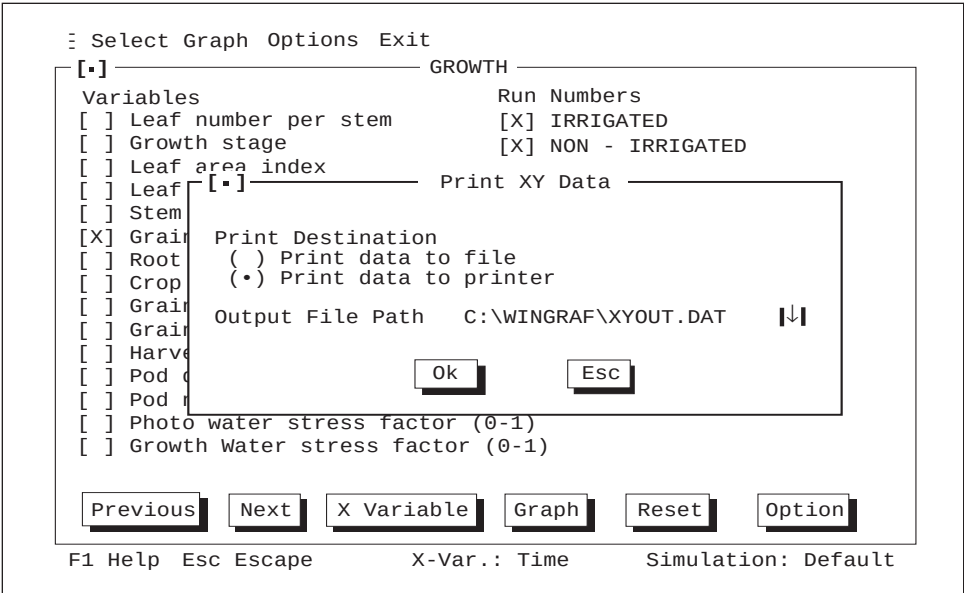
SCREEN 9.

“Output Graph” allows the user to output the current graph to either a printer or a disk file (see Screen 10, below).



SCREEN 10.

“Print Graph Data” allows the user to send the current plot data (and observed data, if present) to the printer or a disk file (see Screen 11, below) in an X-Y format (see Table 1 for an example file of the plot data).



SCREEN 11.

TABLE 1. EXAMPLE FILE OF SIMULATED AND OBSERVED DATA USED TO PLOT THE GRAPH FOR THE GROWTH VARIABLE, “GRAIN DRY WEIGHT” (GWAD).

-----SIMULATED DATA-----				-----OBSERVED DATA-----			
@Day	GWAD	Day	GWAD	Day	GWAD	Day	GWAD
@ X1	Y1	X2	Y2	OX1	OY1	OX2	OY2
166	0.000	166	0.000	194	0.000	194	0.000
169	0.000	169	0.000	201	0.000	201	0.000
172	0.000	172	0.000	208	0.000	208	0.000
175	0.000	175	0.000	215	0.000	215	0.000
178	0.000	178	0.000	222	0.000	222	0.000
181	0.000	181	0.000	229	0.000	229	0.000
184	0.000	184	0.000	236	0.000	236	0.000
187	0.000	187	0.000	243	0.000	243	0.000
190	0.000	190	0.000	250	182.000	250	42.000
193	0.000	193	0.000	257	754.000	257	253.000
196	0.000	196	0.000	264	1912.000	264	471.000
199	0.000	199	0.000	271	2223.000	271	775.000
202	0.000	202	0.000	278	2730.000	278	782.000
205	0.000	205	0.000	285	2913.000	285	1149.000
208	0.000	208	0.000	292	3169.000	292	1206.000
211	0.000	211	0.000				
214	0.000	214	0.000				
217	0.000	217	0.000				
220	0.000	220	0.000				
223	0.000	223	0.000				
226	0.000	226	0.000				
229	0.000	229	0.000				
232	0.000	232	0.000				
235	0.000	235	0.000				
238	0.000	238	0.000				
241	0.000	241	0.000				
244	0.000	244	0.000				
247	29.000	247	29.000				
250	142.000	250	128.000				
253	323.000	253	261.000				
256	580.000	256	418.000				
259	938.000	259	556.000				
262	1290.000	262	634.000				
265	1589.000	265	689.000				
268	1870.000	268	779.000				
271	2127.000	271	836.000				
274	2314.000	274	940.000				
277	2549.000	277	1031.000				
280	2695.000	280	1070.000				
283	2764.000	283	1098.000				
286	2836.000	286	1118.000				
289	2872.000	289	1129.000				
292	2891.000						
294	2899.000						

USER-SELECTED VARIABLES OPTION

When this option is selected, a submenu with two menu items is presented. These allow you to create a file for graph plotting and to define your own list of variables for graphing.

DEFINE

With this menu item, users can create a file for graph plotting provided the file format follows the output file format specified in Part 1 of this Volume (Volume 2-1, Jones et al. 1994). A user-defined file may contain many of the predefined variables in DATA.CDE (see Appendix C of Volume 2-1, Jones et al. 1994). If additional variables are to be plotted, the user may append variable codes and definitions to the DATA.CDE file.

USER-SELECTED

With this menu item, users can select their own variables from those found in the GROWTH, WATER, NITROGEN, DISEASES, PESTS, and CARBON output files. When this item is selected, a window similar to Screen 12, below, is presented. Screen 12 is an example screen showing the list of variables for the GROWTH output file. The right-hand lists presents the Wingraf default GROWTH vari-

```

≡ Select Graph Options Exit
[.]----- User-Selected - (GROWTH)-----
Variables                                     User-Selected
[ ] Leaf number per stem                     [ ] Leaf area index
[ ] Growth stage                             [ ] Leaf dry weight (kg/ha)
[X] Leaf area index                          [ ] Avg plant transpiration (mm/d)
[X] Leaf dry weight (kg/ha)                  [ ] Avg evapotranspiration (mm/d)
[ ] Stem dry weight (kg/ha)                  [ ] Avg potential evapotr (mm/d)
[ ] Grain dry weight (kg/ha)                 [ ] P in grain (%)
[ ] Root dry weight (kg/ha)                  [ ] Lable P Pool (kg/ha)
[ ] Crop dry weight (kg/ha)                  [ ] Active P Pool (kg/ha)
[ ] Grain number (no/m2)                     [ ] Stable P Pool (kg/ha)
[ ] Grain dry weight (mg/grain)               [ ] Percent C in leaf (%)
[ ] Harvest index (grain/top)                 [ ] Percent C in stem (%)
[ ] Pod dry weight (kg/ha)
[ ] Pod number (no/m2)
[ ] Photo water stress factor (0-1)
[ ] Growth Water stress factor (0-1)

Previous Next Ok Esc Reset

F1 Help Esc Escape X-Var.: Time Simulation: Default

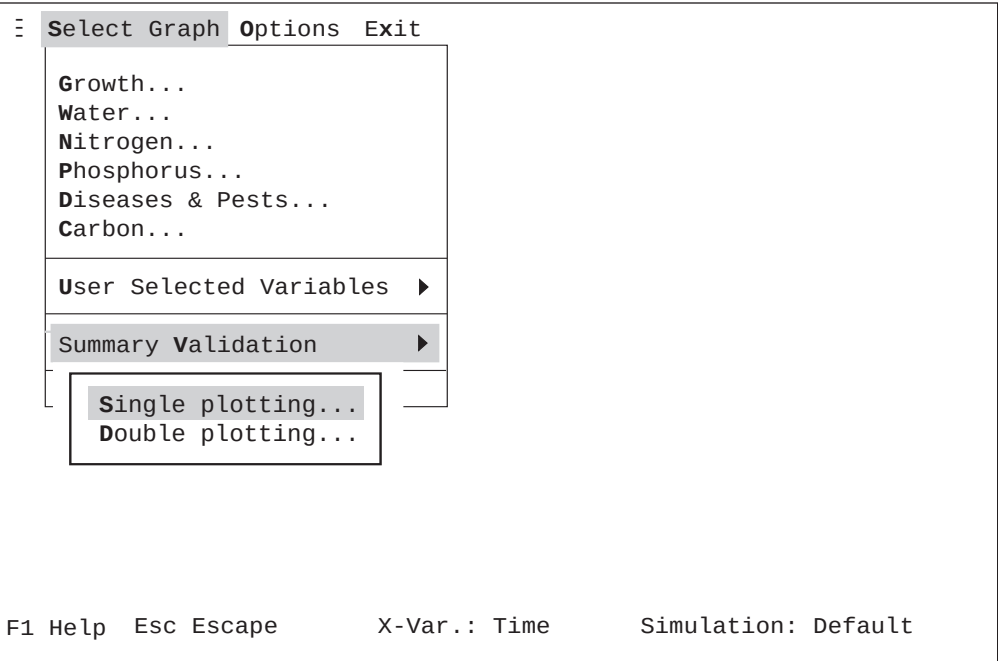
```

SCREEN 12.

ables. The list on the left presents GROWTH output variables which the user may select. After defining the variable list, by putting an “x” beside those variables to be used, users may plot graphs of variables from different variable groups. In this way, key variables from different output files can be displayed simultaneously.

SUMMARY VALIDATION OPTION

This option allows you to visually compare simulated and measured results for a given experiment. Two options are available for summary validations (Screen 13. below). In each case, the model output file, OVERVIEW.OUT, is used.

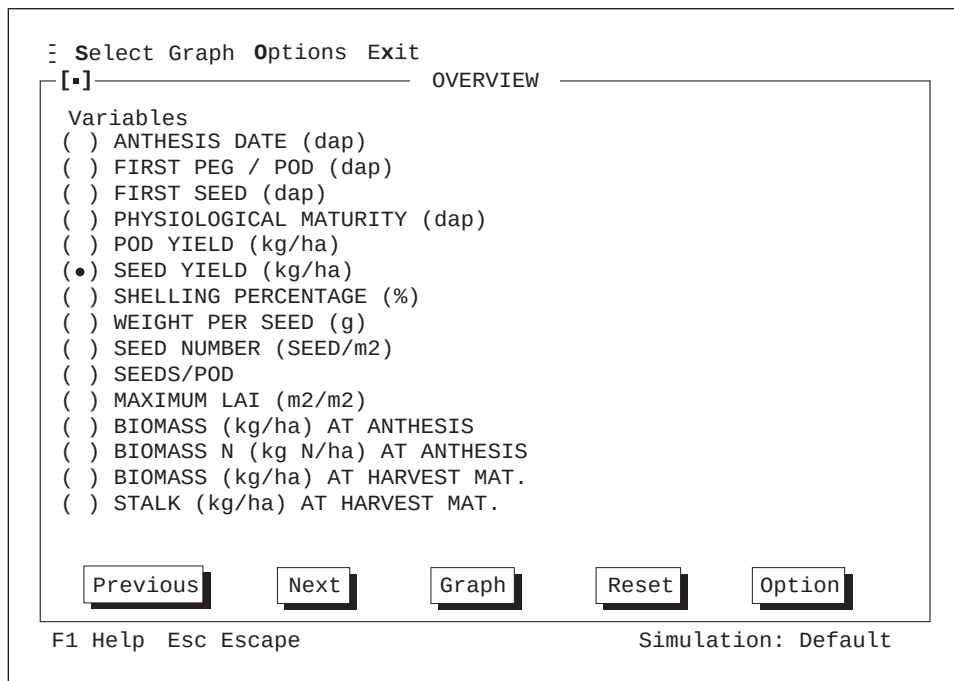


SCREEN 13.

SINGLE PLOTTING

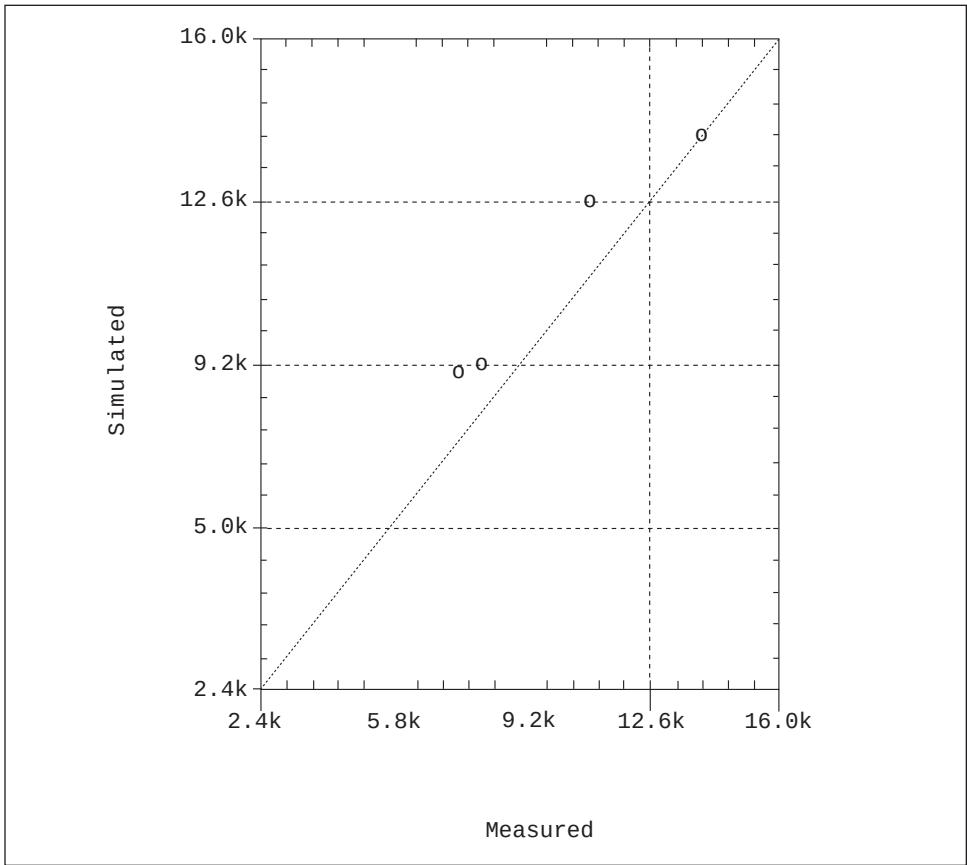
Use “Single Plotting” to select one, and only one, of the variables listed when this menu item is selected (see Screen 14, on following page) for simulated versus observed data plotting. Observed data would be those found in FILEA (see Volume 2-1, Jones et al. 1994, for a description of this file) for a particular experiment. For example, FILEA for experiment UFGA8601.SBX, would be file, UFGA8601.SBA.

When “Single Plotting” is selected, Screen 14 (on following page) is presented.



SCREEN 14.

In Screen 14, “Seed Yield,” has been selected as the variable to be plotted for simulated vs. observed (or measured). Pressing the GRAPH button will display this graph, as shown in Screen 15, on following page.



SCREEN 15.

DOUBLE PLOTTING

Use “Double Plotting” to select only one X and only one Y variable of the variables listed when this menu item is selected (see Screen 16, on following page) for X vs. Y plotting.

≡ Select Graph Options Exit

[.]

SUMMARY

X Variables

[] Simulation start date (YRDOY)

[] Planting date (YRDOY)

[] Anthesis date (YRDOY)

[] Physical maturity date (YRDOY)

[] Harvest date (YRDOY)

[] Planting material wt (kg dm/ha)

[] Tops wt at maturity (kg dm/ha)

[] Yield at maturity (kg dm/ha)

[] Yield at harvest (kg/dm/ha)

[] By-product harvest (kg dm/ha)

[] Wt at maturity (mg dm/unit)

[] Number at maturity (no/m2)

[] Number at maturity (no/unit)

[] Irrigation applications (no)

[X] Season irrigation (mm)

Y Variables

[] Simulation start date (YRDOY)

[] Planting date (YRDOY)

[] Anthesis date (YRDOY)

[] Physical maturity date (YRDOY)

[] Harvest date (YRDOY)

[] Planting material wt (kg dm/ha)

[] Tops wt at maturity (kg dm/ha)

[X] Yield at maturity (kg dm/ha)

[] Yield at harvest (kg/dm/ha)

[] By-product harvest (kg dm/ha)

[] Wt at maturity (mg dm/unit)

[] Number at maturity (no/m2)

[] Number at maturity (no/unit)

[] Irrigation applications (no)

[] Season irrigation (mm)

Previous

Next

Graph

Reset

Option

F1 Help

Esc Escape

X-Var.: Time

Simulation: Default

SCREEN 16.

SUMMARY RESPONSE OPTION

This option is used for summary graph plotting. Only one X and one Y variable can be selected for graph plotting. When this option is selected, Screen 17 (on following page) is presented.

DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3,

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Select Graph Options Exit

[.]

SUMMARY

X Variables

[] Simulation start date (YRDOY)

[] Planting date (YRDOY)

[] Anthesis date (YRDOY)

[] Physical maturity date (YRDOY)

[] Harvest date (YRDOY)

[] Planting material wt (kg dm/ha)

[] Tops wt at maturity (kg dm/ha)

[] Yield at maturity (kg dm/ha)

[] Yield at harvest (kg/dm/ha)

[] By-product harvest (kg dm/ha)

[] Wt at maturity (mg dm/unit)

[] Number at maturity (no/m2)

[] Number at maturity (no/unit)

[] Irrigation applications (no)

[X] Season irrigation (mm)

Y Variables

[] Simulation start date (YRDOY)

[] Planting date (YRDOY)

[] Anthesis date (YRDOY)

[] Physical maturity date (YRDOY)

[] Harvest date (YRDOY)

[] Planting material wt (kg dm/ha)

[] Tops wt at maturity (kg dm/ha)

[X] Yield at maturity (kg dm/ha)

[] Yield at harvest (kg/dm/ha)

[] By-product harvest (kg dm/ha)

[] Wt at maturity (mg dm/unit)

[] Number at maturity (no/m2)

[] Number at maturity (no/unit)

[] Irrigation applications (no)

[] Season irrigation (mm)

Previous

Next

Graph

Reset

Option

F1 Help

Esc Escape

X-Var.: Time

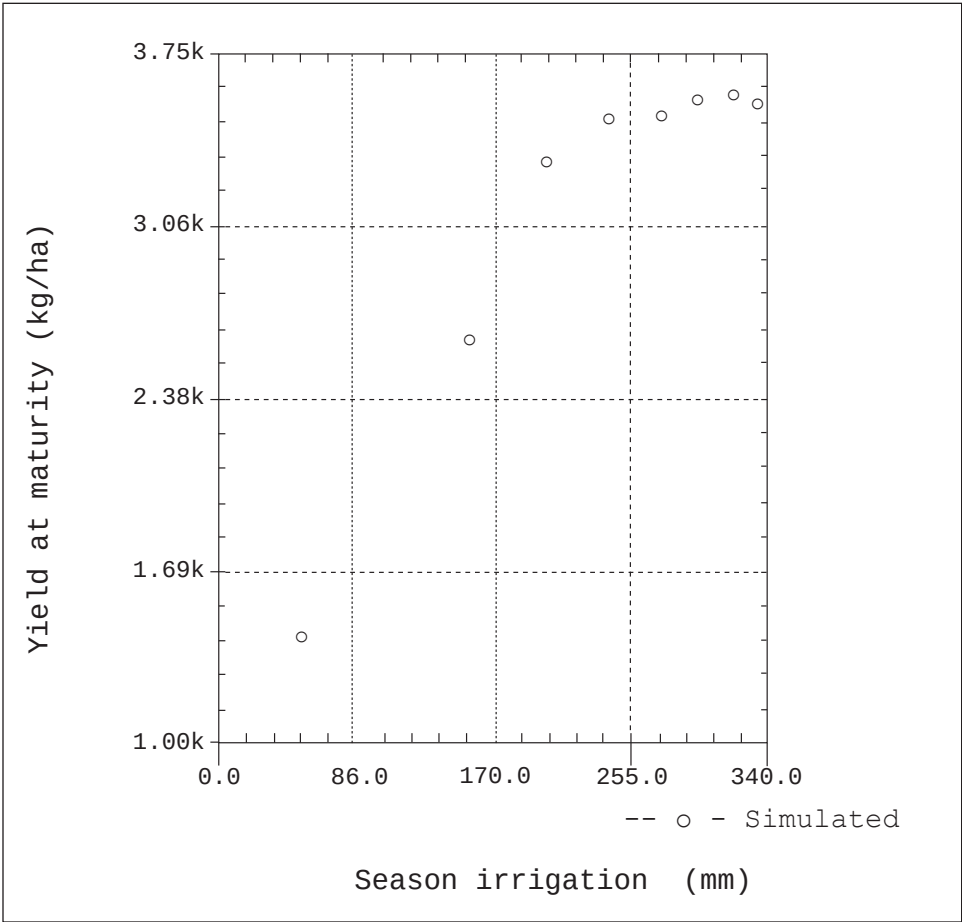
Simulation: Default

SCREEN 17.

In Screen 17, “Season irrigation” has been selected as the X-variable and “Yield at maturity” as the Y-variable. Pressing the GRAPH button will display this graph, as shown in Screen 18, on following page.

e 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3, Volume 2 • DSSAT v3,

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SCREEN 18.

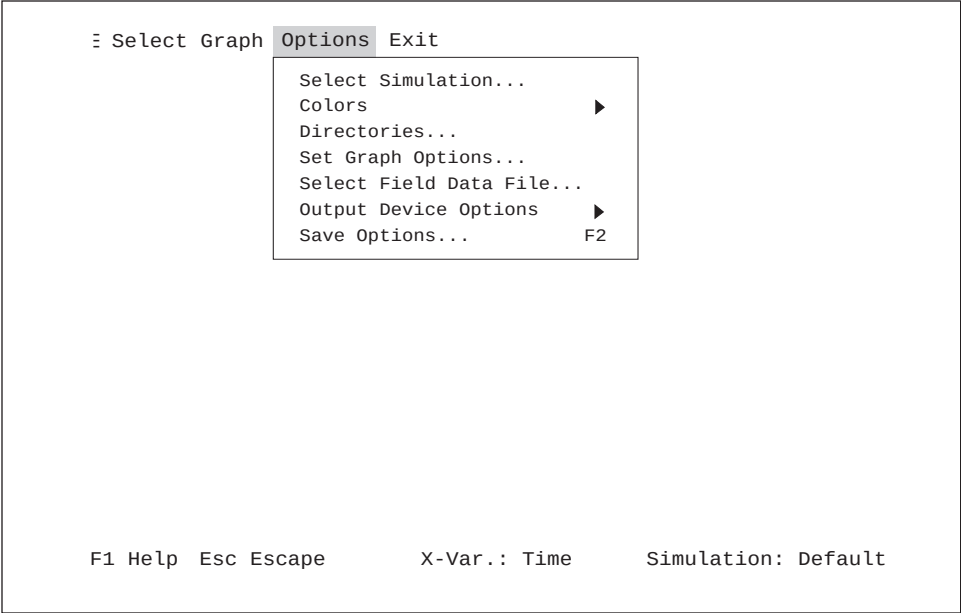
In Screen 18, the example graph displays “Yield at harvest” plotted against “Season irrigation.”

CHAPTER FIVE.

OPTIONS MENU

The OPTIONS menu item allows the user to select previously run simulations and to modify the operation, look and feel of Wingraf. The user may define most of the operational parameters, configure Wingraf, and select previous simulations (Screen 15).

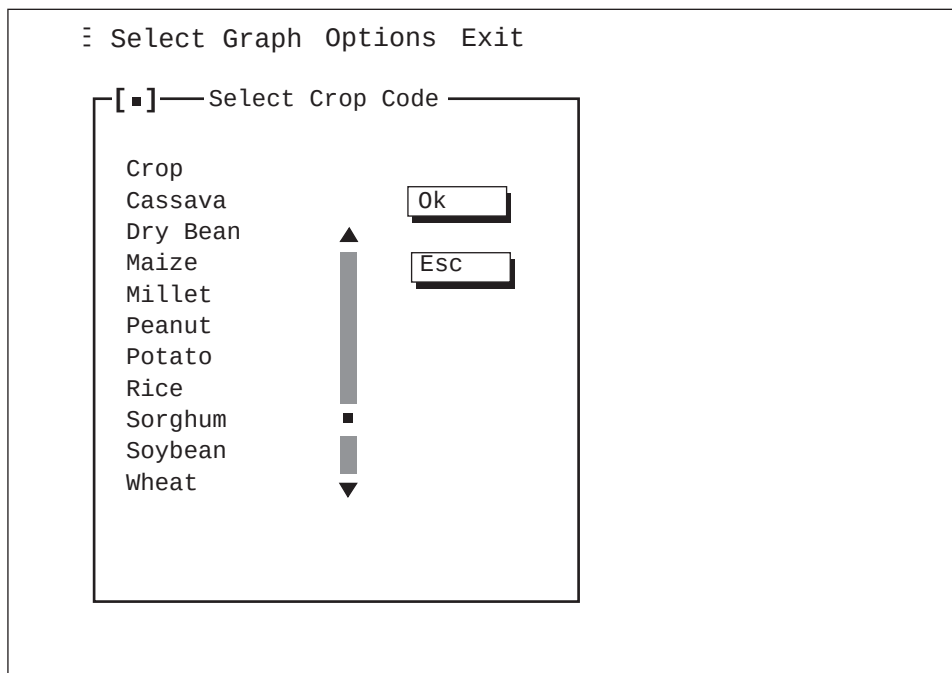
When the OPTIONS menu item is selected, the pull-down menu shown in Screen 19 (below) is displayed.



SCREEN 19.

SELECT SIMULATION OPTION

With this option, users can select previously simulated results provided the default output file names have been changed. Selecting this option opens the crop dialog box shown in Screen 20 (on following page).

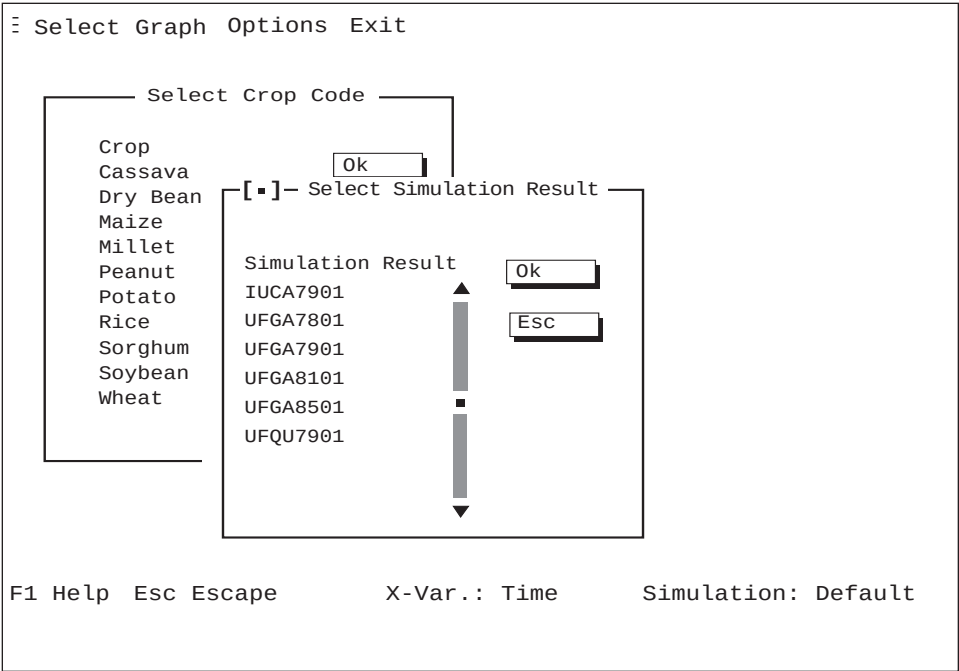


SCREEN 20.

If simulations have been run for any of the crops listed in this box and the output file names have been changed from the default names (e.g., from GROWTH.OUT), then selecting one will present a listing of output files. For example, if Soybean is selected from the crop code dialog box in Screen 20, and the output names have been changed, then those files will be displayed. For the UFGA7801-Soybean experiment, these might be, UFGA7801.SBG, UFGA7801.SBW, UFGA7801.SBN for GROWTH.OUT, WATER.OUT, NITROGEN.OUT, respectively.

When one of the crops listed is selected and simulations have been run with output names changed, then Screen 21 (on following page) will appear.

If no previous simulation results have been saved with the experiment-coded file names described above, a message will appear on the screen to inform the user of this.

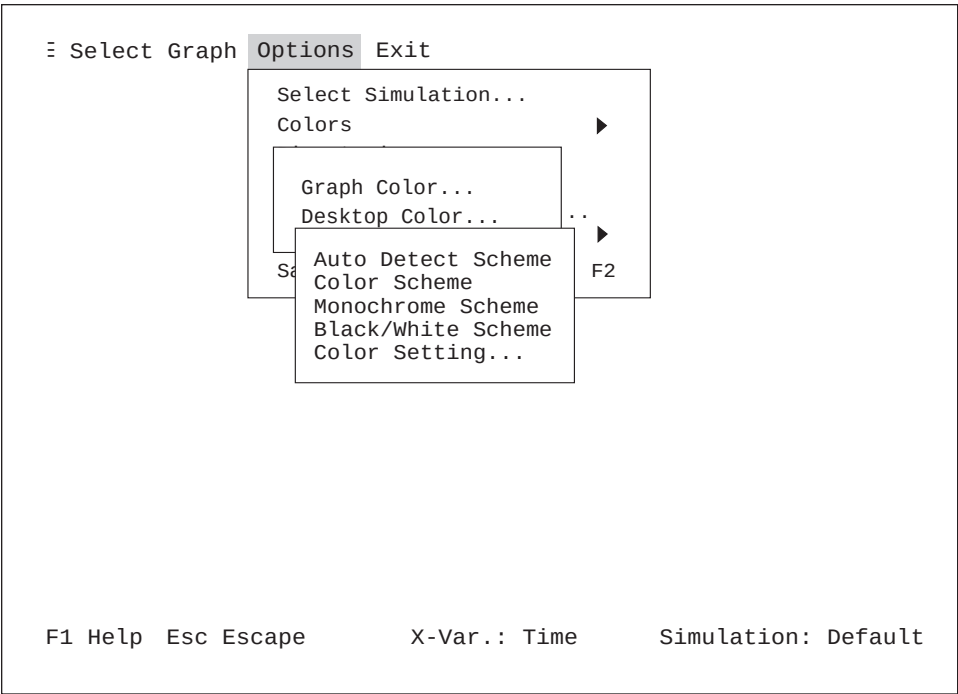


SCREEN 21.

In Screen 21, a listing of available simulation results is presented. Any listed simulation may be chosen and then plotted.

COLORS OPTION

Colors for both graphics and the desktop may be selected by choosing the Colors menu option (Screen 22, below).



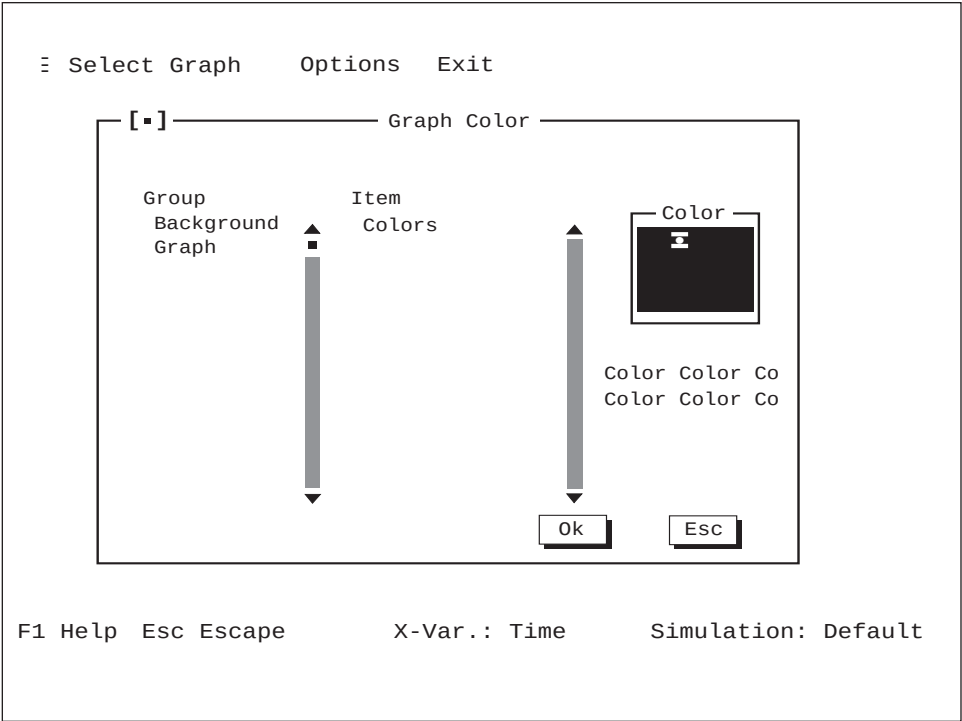
SCREEN 22.

GRAPH COLOR

Select “Graph Color” to define the colors used for graph plotting, such as graph background and line color. When “Graph Color” is selected, a listing of color schemes is presented (see Screen 22, above).

Select one of the first four items listed and the graph background and line color will be adjusted to that described in each listing. For example, if “Auto Detect Scheme” is selected, the program will use its default colors. Or, if “Black/White Scheme” is selected, the program will convert colors to black and white.

If “Color Setting” is selected, the user may customize the colors used according to his/her individual preference. When this menu item is selected, Screen 23 (on following page) will be presented.



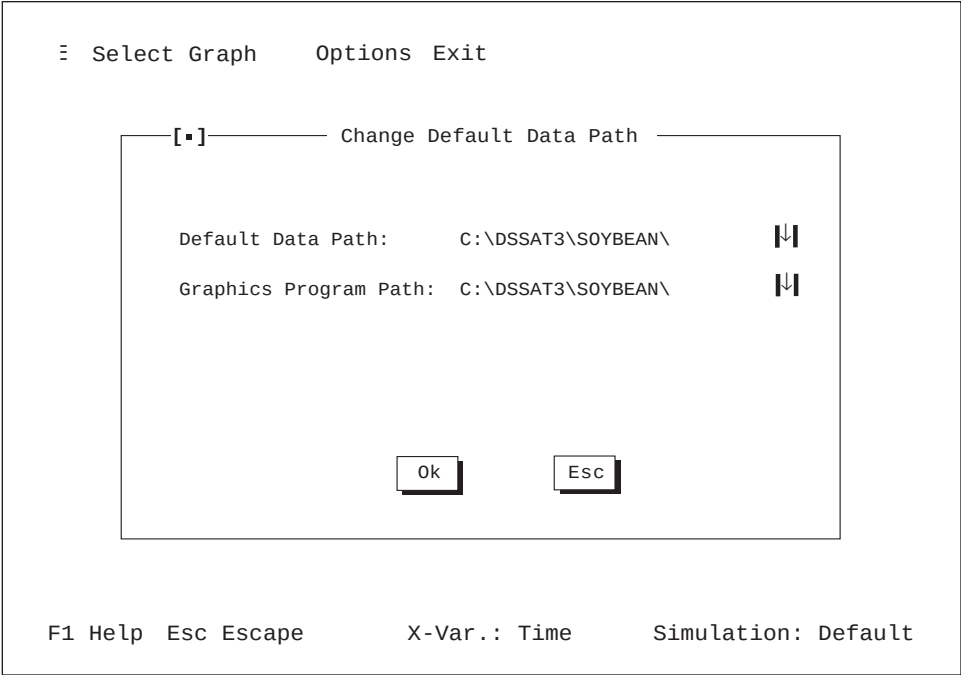
SCREEN 23.

DESKTOP COLOR

Use “Desktop Color” to customize the desktop color scheme as well as the color setting for individual desktop displays. When “Desktop Color” is selected, a screen similar to the one shown in Screen 23 (above) will be presented, in which a user can select colors for background color of the desktop, dialog boxes, menus, the viewer and so on.

DIRECTORIES OPTION

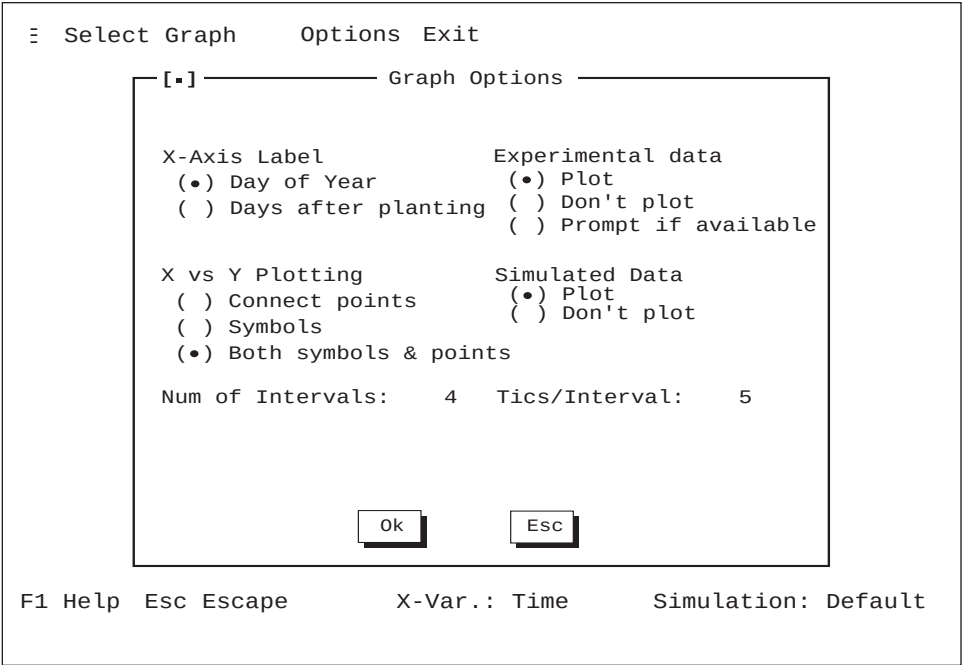
This option allows the user to change the default path for graph plotting. When this option is selected, Screen 24, below, is presented. The Graphics Program Path, which can also be changed in Screen 24, will not normally need to be changed.



SCREEN 24.

SET GRAPH OPTIONS

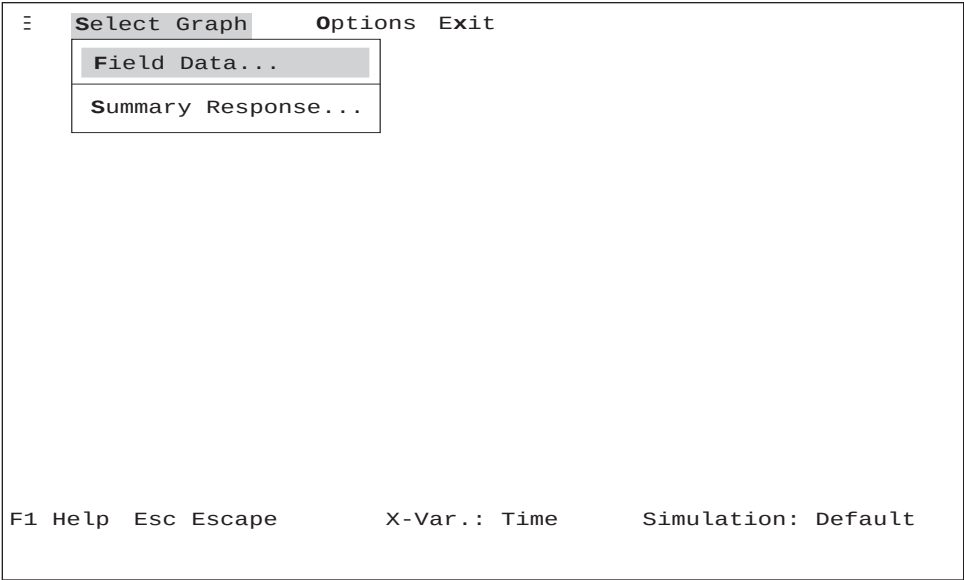
This option allows the user to specify various graph options as shown in Screen 25, below.



SCREEN 25.

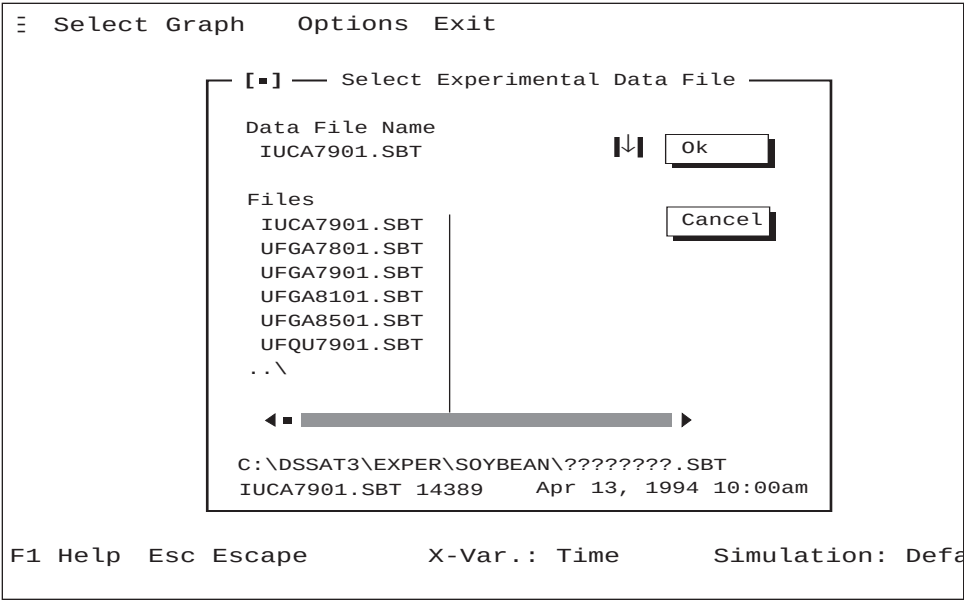
Make selections in Screen 25 and then press the OK button to save them. Press the ESC button if you do not wish to save your selections.

***NOTE:** If under the Simulated Data option, “Don’t plot” has been selected, then the pull-down menu under the SELECT GRAPH menu item of the Wingraf main menu screen will change as shown in Screen 26, on following page.*



SCREEN 26.

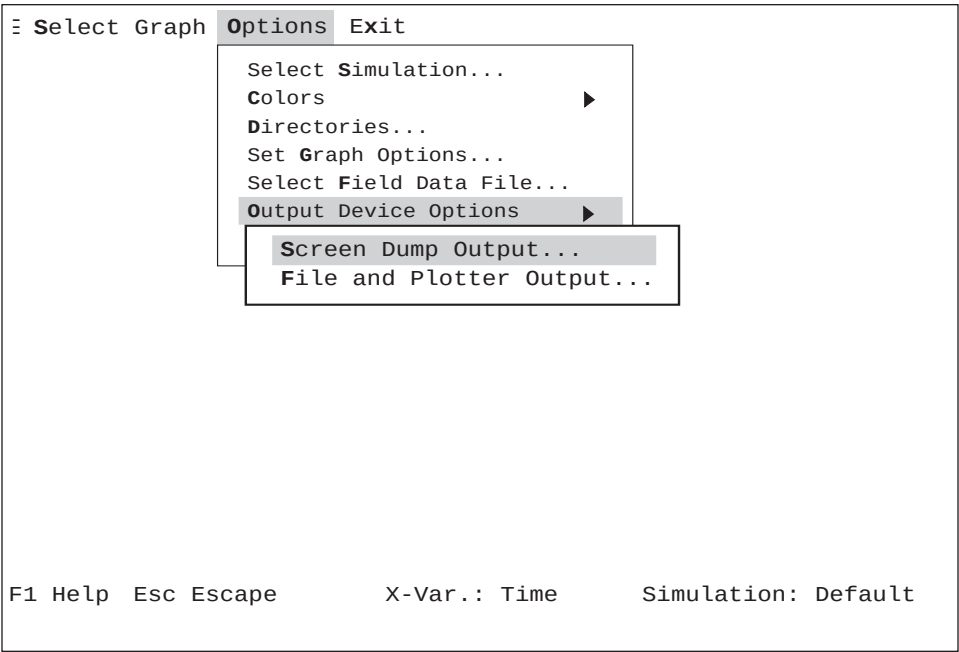
When “Don’t plot” is selected from the Simulated Data options in Screen 25, you must open the “Field Data” menu item under SELECT GRAPH and select a field data file for graph plotting. When “Field Data” is selected, Screen 27 (below) is presented with a listing of data files available.



SCREEN 27.

OUTPUT DEVICE OPTIONS

This option allows the user to configure both screen dump output and plotter/file output. When this option is selected, Screen 28 (below) is presented..



SCREEN 28.

SCREEN DUMP OUTPUT

Use “Screen Dump Output” to set up the graph output option as a screen-dump and to select a printer device, printer port, orientation, and other options shown in Screen 29 (on following page).

SCREEN 29.

FILE AND PLOTTER OUTPUT

Use “File and Plotter Output” to select the graph output option to file output or to both plotter output and file output (see Screen 30, below). The output file can be in either HPGL or Postscript format. The graph file can be imported into other graphic editors, word processing program or drawing programs for further modification.

SCREEN 30.

SAVE GRAPH OPTIONS

Changes made with the “Set Graph Options” or “Save Options” menu items under OPTIONS in the Wingraf main menu saves selected configurations to the file called GRAPH.INI. Normally, Wingraf configuration data will be handled and updated through the Wingraf menu structure. You may wish, however, to edit GRAPH.INI with a text editor. Thus, a listing of the contents of GRAPH.INI which pertains to Wingraf is shown in Table 2.

Two sections of GRAPH.INI hold configuration data for Wingraf and for the default output device. Under the [WINGRAF] section of the GRAPH.INI file, defaults for plotting in Wingraf are defined. Specifically, they are:

gcolor0 to gcolor7:	Refer to the default color palette for plotting.
interval:	Number of major divisions on the X and Y axis.
tics:	Number of tic marks between the major divisions.
days:	‘D’ for day after planting date; ‘Y’ for day of year.
symbols:	‘C’ for connect symbols with lines; ‘S’ for plotting symbols alone; or “B” for both symbols and lines.
thickness:	‘T’ for thick lines; ‘N’ for normal width lines
plot:	‘P’ for plot simulated data; ‘D’ for don’t plot simulated data.
exp:	‘A’ for always plot experimental data; ‘N’ for never plot; or
‘P’ for	prompt when data are available.

Under the [Device] section of the INI file, defaults for the selected output device in Wingraf are defined. Specifically, they are:

output:	‘S’ for screen Dump; ‘P’ for plotter and file output; or ‘F’ for
file	alone.
driver:	“0” for Epson MX; “1” for Epson LQ; “2” for Epson FX; “3”
for	Toshiba P; “4” for HP Laser Jet; or “5” for HP Ink
Jet.	
plotter:	“0” for HPGL or “1” for Postscript.
port:	“0” for LPT1; “1” for LPT2; “2” for COM1; or “3” for COM2.
orientation:	“0” for Portrait or “1” for Landscape.
resolution:	Resolution.
xmult:	X-multiplier.
ymult:	Y-multiplier.
file:	Name for file output.

TABLE 2. *EXAMPLE OF A WINGRAF GRAPH.INI FILE.*

```
[WINGRAF]
gcolor0=1
gcolor1=15
gcolor2=14
gcolor3=12
gcolor4=15
gcolor5=10
gcolor6=11
gcolor7=13
interval=4
tics=5
days=Y
symbols=B
thickness=T
plot=P
exp=N
[Device]
output=F
driver=1
plotter=1
port=2
orientation=0
resolution=1.00
xmult=1.00
ymult=1.00
file=C:\WINGRAF\OUTPUT00.GRA
```

REFERENCES

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International Benchmark Sites Network for Agrotechnology Transfer Project. 1989. Decision Support System for Agrotechnology Transfer Version 2.1 (DSSAT V2.1). Dept. Agronomy and Soil Sci.; College of Trop. Agr. and Human Resources; University of Hawaii; Honolulu, HI.

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NOTES:

